Design News

Coil-spring clutches achieve 8-millisecond response time in servo-actuator. Page 12

A ROGERS PUBLICATION

MARCH 13, 1961

NEW DEPARTURES IN MINIATURE

ULTRA-CLEAN INCUBATORS FOR M/I* BALL-BEARINGS

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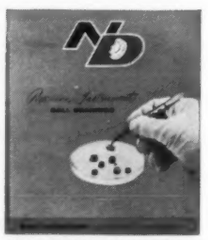
*Miniature and Instrument Ball Bearings.



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NBP March 13, 1961 Vol. 16 No. 6 BPA
Worldwide Coverage of Technical

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Published bi-weekly by Rogers Publishing Co. Editorial, Advertising and Subscription Offices: 3375 S. Bannock, Englewood, Colo. Telephone: SUnset 9-0571.

Printed at 85 W. Harrison St., Chicago 5, Ill. Accepted as Controlled Circulation Publication at Chicago, Illinois. Send form 3579 to subscription offices.

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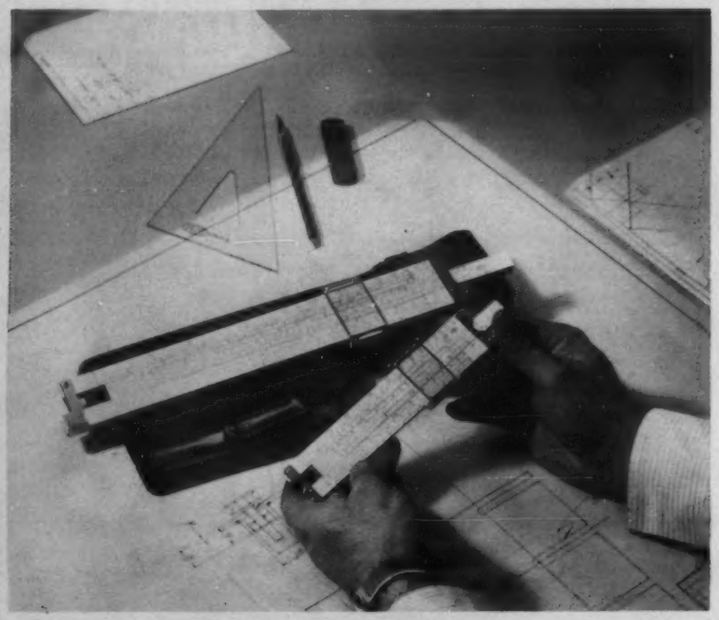

This is a size comparison between the 10" POST Versalog and its 5" replica, the POST Pocket Versalog.

The trend to "COMPACT" slide rules

Why a small slide rule?

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That there is a need has since been proved by the thousands of engineers, architects, scientists, and students who have bought and used a POST Pocket Versalog in preference not only to the larger version, but after comparing it with other smaller makes.

As to accuracy, we are still amazed at the exquisite job our production team has done in miniaturization—the 5" Pocket Versalog includes every one of the 23 scales found on its much larger counterpart and, in addition, bears engine-divided calibrations of such sharpness and clarity that no magnifier is needed.

Own a Versalog for less

To further popularize this fine instrument, POST dealers are offering it at a special low price for a limited time. All models come with a handcrafted leather case and spring pocket clip. Also available with hardbound instruction text.

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DESIGN VIEWS

An Ethical Illegality?

District Judge J. Cullen Ganey sentenced 29 electrical manufacturing companies and 45 of their executives early in February for price rigging. The public reaction has been a mixture of shock, disillusionment and criticism.

Based upon the court's finding of fact, there is no question of the illegality of the action taken by the companies. However, the defendants in this case—both companies and executives—are entitled to have the other side of the coin publicly examined before they are stoned and thrown to the lions.

Twenty-nine companies are involved—from the giants, General Electric and Westinghouse, to small companies. The charge was collusion in setting prices. First, consideration should be given as to who gained from these artificially high prices and therefor presumably artificially high profits. The biggest benefit of course went to the government, who gets 52 percent of the profits. Presumably the owners of these companies were next in line; however, in General Electric and Westinghouse alone there are some 556,400 owners. Finally the employees of these companies benefited through continuing employment from the business "passed around". The published accounts of the trial have never indicated that individual executives involved received any special personal gains from these actions. It would appear that gain, for gain's sake, may *not* have been the motivating factor in this collusion.

There has been no evident complaint that this price fixing was for the purpose of driving out competition—quite the reverse is claimed. The damage has been shown to be against the users of the products of these manufacturers. If the entire industry is in this, and if the gains are accruing largely to the government through taxation of profits, dividends and wages, then why did these companies accept the risks of collusion?

Is it possible that collusion in price fixing was necessary to protect the very free enterprise system Judge Ganey felt was in jeopardy by this action? In the area of large dollar contract units in this industry, might not the giants *always* be able to bid low? These huge companies can bring to bear the highly competitive advantages that only large volume purchases produce. Their talented research teams in processing, tooling and manufacturing create competitive advantages not available to the small manufacturer. Arguments that the little producer can undersell the big producer are frequently true, but apparently not applicable in the heavy electrical equipment manufacturing business.

If the giants had aggressively bid their lowest possible price over the last 25 years, would there be 29 companies in this field today?—Or maybe only 8—or only 2? And if only 2 survived, would the government sue for the elimination of this monopoly, even though the buyers had benefited through the lowest possible prices for 25 years?

Perhaps our society has the choice of monopolies where the few most competitive producers end up being the few *only* producers—or, on the other hand, where an industry acts in concert to keep alive big and small, within reason, to insure the survival of the kind of an economy which has made America great.

It is lamentable that existing economic philosophies are such that executives of stature have felt it necessary to go outside of the law to insure the survival of their industry. However, this industry may have taken the only ethical way out of its dilemma—the illegal way.

President

In this issue we offer two different viewpoints on a subject of current controversy. E. R. C.

Consequences of Conspiracy

The antitrust prosecution of 29 firms in the heavy electrical equipment industry jolted me as I am certain it did many others. I had looked with awe and envy at these and other titans of industry as leaders who had become big and powerful by forceful and dynamic leadership. Now I wonder.

In any organization the moral tenor, management strength, honesty and integrity stem from number one in the company. His conduct and demeanor have a way of filtering down to all subordinate levels of an organization. This is true be it a business, government or social fraternity.

I mention this because I find it difficult to believe that the presidents and board chairmen of these manufacturing companies were unaware of this illegal activity. If, indeed, they were as uninformed as we now would be led to believe, it certainly casts some reflection upon their ability and competence as chief executives.

The conviction of the 45 executives is a personal tragedy for them and their families. Few will regain the respect or positions of responsibility they held prior to serving jail sentences.

World War II seems to have spawned a period in which it was smart to "cut a few corners". There were signs of this decay of morality in government, business and social life. Much of it remains today. Perhaps this is a partial explanation of why a man who is respected as a civic leader of his community finds himself revealed as a social and corporate "Dr. Jekyll and Mr. Hyde". To me there appears danger of a tragedy which far overshadows the personal loss to these individuals and their families and the companies' loss in prestige and possible damage claims. It is doubtful that the total assets of these 29 firms could offset the damage done to the U. S. industrial complex.

Consider, for instance, the propaganda value to Russia. What dollar figure would you assign to this if you were the commissar in charge of sabotaging the capitalistic system in general and U. S. industry in particular?

Companies double-dealing their own government do little to engender confidence in buyers from other parts of the world. How much foreign trade will be curtailed by a growing suspicion that similar conspiratory practices will be followed against buyers from overseas?

The last few years have seen a steady stream of top labor leaders paraded before investigating committees. So many have "taken the fifth" that one must conclude that the honest union leader is a rarity. How many people will now assume that both labor and management need a good general housecleaning?

By far the greatest peril resulting from this conspiracy is the danger that it may be used as a means of furthering socialism in this country. The pattern has been observed in other countries. Weaken the giants in a single industry and then the government must take over the whole industry to protect the interests of the people.

I sincerely hope that I am only seeing "dragons in daylight" and that the future conduct of management in these companies will restore confidence and strength necessary to prevent any movement toward socialism.

Socialization of this or any other industry would put politicians in a position to set prices legally, the very thing for which 45 executives were sent to jail.

Ernest R Cunningham

Editor

Thoroughly Proved...
BY YEARS OF HARD EVERYDAY USE ON FLUID LINE CIRCUITS IN THOUSANDS OF PLANTS
HANSEN
QUICK-CONNECTIVE
PUSH-TITE COUPLINGS

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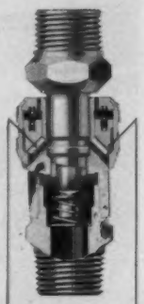
—AS EASY AS PLUGGING IN YOUR ELECTRIC SHAVER



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- Quick connection and disconnection—as easy as plugging in your electric shaver.
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Representatives in Principal Cities... See Yellow Pages

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DESIGN ENGINEERING NEWS

Subway Train Runs on Pneumatic Rubber Tires

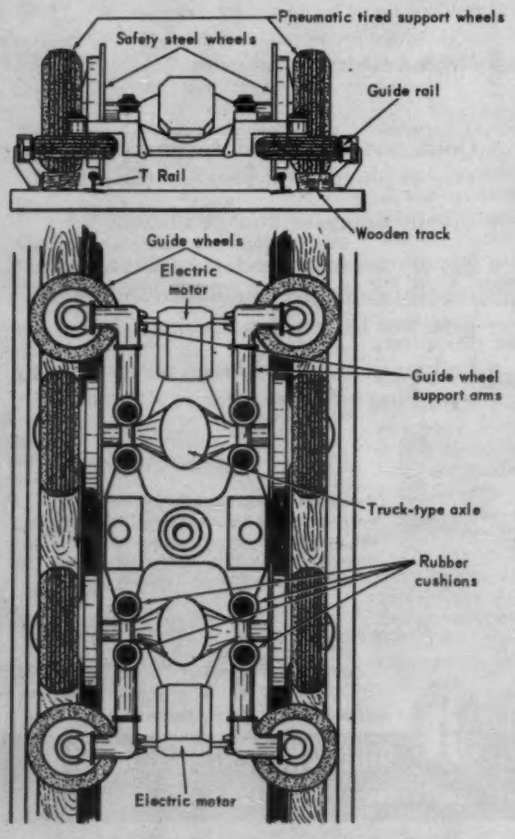
George B. Bernard, Correspondent in France

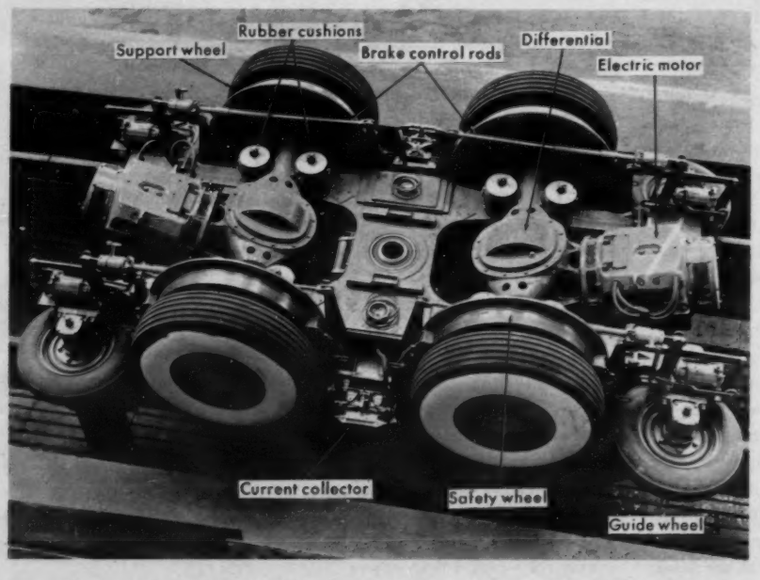
PARIS, FRANCE—Pneumatic rubber tires running on hardwood tracks support the weight of a new subway train, while additional wheels, also rubber-tired but on vertical axes, run against current feed-rails to provide lateral guidance. Standard steel track and flanged wheels are kept mainly as a safety factor in case of tire failure and are normally not in contact. The train is claimed to be 35 percent lighter and 15 percent cheaper to build than standard designs. It also starts and stops more quickly and uses less power.

Each bogie has two automobile-type axles, individually driven by 140-hp electric motors working through worm-gear transmissions built into the differentials. The brake system is standard railroad design, but uses impregnated wooden shoes pressed against the steel wheels. Wipers against side and track rails complete the electric power-supply circuit and operate normal signaling devices.

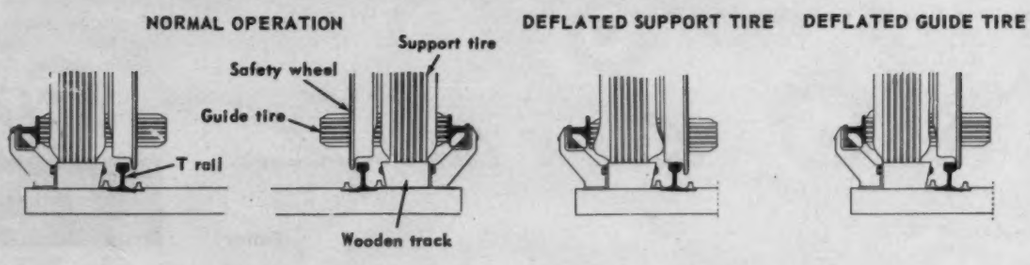
Tires are Michelin steel-cord bus tires, nitrogen-inflated to 130 psi for motor bogies and 94.2 psi for trailer bogies. Lateral guidance tires are nitrogen-inflated to 143.2 psi. Relatively constant ambient temperature and humidity prolong tire life substantially.

The train was designed by Regie Autonome des Transports Parisiens, 53ter, Quai des Grands Augustins.





AXLES are sprung by four rubber cushions each. Arms carrying guide wheels are hinged on vertical shafts common to axle support cushions. Car body is sprung on bogie by steel coil springs; 600v d-c motors are mounted directly to each differential.



Annular Venturi Mixes in Air To Burn Exhaust Gases

Edward W. Schrader, Western Editor

LOS ANGELES, CALIF.—A flame-type afterburner is designed to eliminate smog-causing hydrocarbon gases from automobile engine exhaust. Exhaust gases pass through an annular venturi to a combustion chamber. Suction at the throat of the venturi draws in air to mix with exhaust gases.

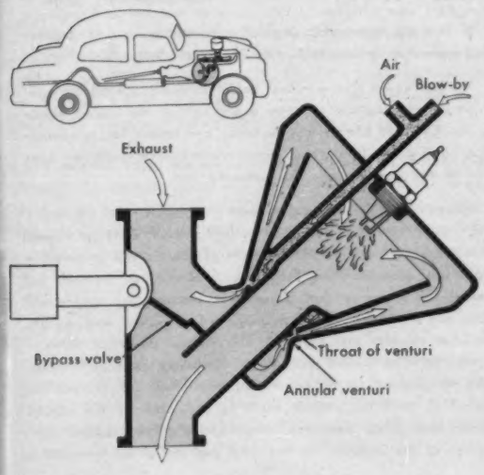
A spark plug in the combustion chamber ignites the combustible mixture. The burning gases heat the wall of the combustion chamber, which in turn serves as a heat exchanger and preheats the entering gas mixture.

The normal passageway for the exhaust gases incorporates a weighted bypass valve. This valve directs the exhaust through the venturi. Under low gas-flow conditions, such as idling and deceleration, all the gases are directed through the venturi.

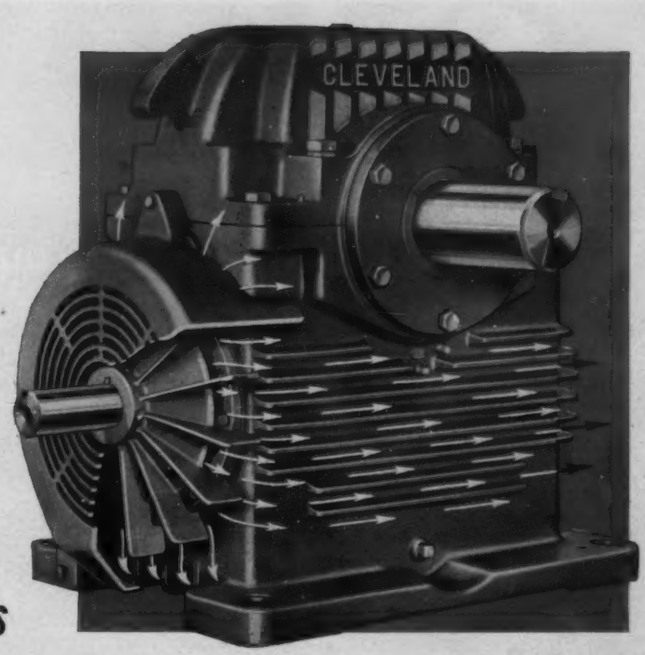
At higher gas-flow, when the throttle is opened, the bypass valve also opens. This allows the excessive gas-flow to bypass the combustion chamber and go directly to the exhaust pipe. Under these operating conditions, it has been found that the need for extra air is minimal. The venturi and combustion chamber need not be proportioned for maximum gas-flow conditions.

Blow-by from the crankcase is admitted to the air intake. This serves to supply the principal portion of the air requirement. Additional air is drawn from the surrounding atmosphere as required.

The Chromalloy Corp., developer of the "Smog Burner", points out that back pressure of the exhaust, caused by the bypass valve, will have no adverse effect on gasoline mileage or engine operation.



Fan cooling for Increased HP Capacity is Not New... *to users of Cleveland Speed Reducers*



As far back as 1944, Cleveland Speedaire Worm Gear Reducers (shown in both the announcement ad and cutaway photo below) were providing industry twice the load carrying capacity then available from standard worm gear units of equal frame size. Even then, it was *fan cooling* that did the trick—because fan cooling was and still is the most practical method of heat dissipation.

On the new, higher horsepower Cleveland's (shown in top cutaway photo), a small, specially designed fan—equally effective in either direction of rotation—is located on the worm shaft's input side. Fan size and design permit a smooth, more effective flow of air beneath, above, and around all sides of the reducer.

Mounting the cooling fan on the worm shaft INPUT end is a very definite Cleveland advantage for when the fan is mounted on the *opposite* side, a second oil seal is needed. This results in additional friction loss due to seal drag—and is another point where oil leakage could occur.

Remember, it was Cleveland design engineers who pioneered both fan cooling and centrifugal casting of bronze gears—and after sixteen years of rugged field usage in all types of industrial plants, have now incorporated these features in all units (from 3 to 12-inch centers) of the new standard Cleveland Speed Reducer line.

Get the story of these new speed reducers from your Cleveland representative, or write today for free 36-page illustrated Bulletin No. 410 that contains complete engineering information. Either way, you will get the answer to improved speed transmission—at savings of 50% or more on per horsepower cost!

A 1944 CLEVELAND AD
"Announcing A Fan-Cooled Worm Gear Speed Reducer . . . SPEEDAIRE."

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Speed Reducers

Cleveland Worm & Gear Division
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Everything about this combination fan blade-turbine bucket is new except its predictable performance . . . a built-in characteristic of all Carpenter high temperature alloys.

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Carpenter's VACUMELTROL® (induction vacuum) and CONSUMET® (consumable electrode) melting processes assure you more accurate forgings with better finishes, fewer rejects, faster production . . . and, most important . . . true predictable performance in your high temperature alloy components. Ask your Carpenter Representative for details.

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SEEN AND HEARD

Spare Parts Dilemma—Some Answers

Edward W. Schrader, Western Editor

THE QUESTION

A reader has raised a good question, ". . . You do not explain how you would retain proprietary rights and still place all such data on drawings or other documents."

To date, the Armed Services Procurement Regulation IX, (2) and specification MIL-D-70327 are not revised.

The Report of the Select Committee on Small Business in the House of Representatives shows a great awareness of the conflict. The report states: "The problems presented to the subcommittee in connection with proprietary rights in data can be delineated as follows:

1. Delivery of manufacturing data to the government whereby the government contractor subjects himself to the gravest possible consequences caused by the government making his trade secrets available to competitors.

2. The taking without compensation, either by the government or the prime contractor, of the manufacturer's proprietary data developed by him at great expense over long periods of time.

3. Protecting the government's interest in the furtherance of its national defense insofar as the government has a legitimate or necessary concern with the creation of secondary sources of supply in order to broaden the procurement base."

LONG-RANGE "SOLUTION"

The committee unanimously makes the following recommendations:

"1. An ad hoc committee consisting of members of government and industry be established by the Department of Defense for the purpose of redefining proprietary rights in data and making recommendations for rewriting of ASPR IX, part 2.

2. A study can be made by the Department of Defense to determine a method of operation whereby both prime contractors and subcontractors (1) will be able to submit evidence as to the existence of their proprietary rights in data and (2) prime contractors and subcontractors will be permitted to submit evidence to prove the dollar value of their proprietary rights.

3. That the appropriate legislative committee consider legislation amending section 1498, title 28, United States Code."

The bill would give a patent holder recourse against infringement by allowing him to enter a suit against the United States in the Court of Claims and to bring civil action for compensation against the firm which manufacturers—even with the consent of the government—the patented item.

Industry concurs in principle with the report. The Machinery and Allied Products Institute states that present ASTR provisions should be revised: (1) to recognize a contractor's proprietary right and manufacturing know-how developed at his own expense; (2) to insure that government requests for proprietary data are not made indiscriminately, are minimized and reasons for such requests are disclosed; (3) to guarantee that the contractor is compensated adequately for unlimited rights to use such information, to the extent that the unlimited rights are obtained in individual cases. MAPI is composed of the capital goods and allied equipment manufacturers. The member companies of the institute, for the most part not primarily defense

contractors, produce a substantial amount of highly engineered equipment as well as certain off-the-shelf-type items.

The Strategic Industries Association, representing small business, takes nearly the same stand. Its members consist of the subcontractors to the aero/space industry, which has been nursing at the breast of the government since its existence.

SHORT-RANGE "SOLUTION"

Until relief is obtained, SIA states that industry must aggressively defend its own rights, though it is willing to cooperate with DOD in the pursuit of the mandate from Congress.

In the meantime, SIA recommends that industry must deal with representatives of government as individuals and not as symbols of sovereignty. These approaches are open to individual firms:

1. The Comptroller General of the United States, in a recent decision (B-143711, dated Dec. 22, 1960), held that the government should not infringe a proprietary right by competitive procurement. Here is a decision which may be used as a precedent.

2. For those who have the means, the dual drawing technique might be continued.

3. In recent months four organizations, International Electronic Research Corp., Airborne Research Development Corp., Parker Aircraft Co. and Robbins Aviation Co., have defended themselves successfully against loss of proprietary rights. They took positive action against the military organization that was obtaining competitive bids in violation of their proprietary position.

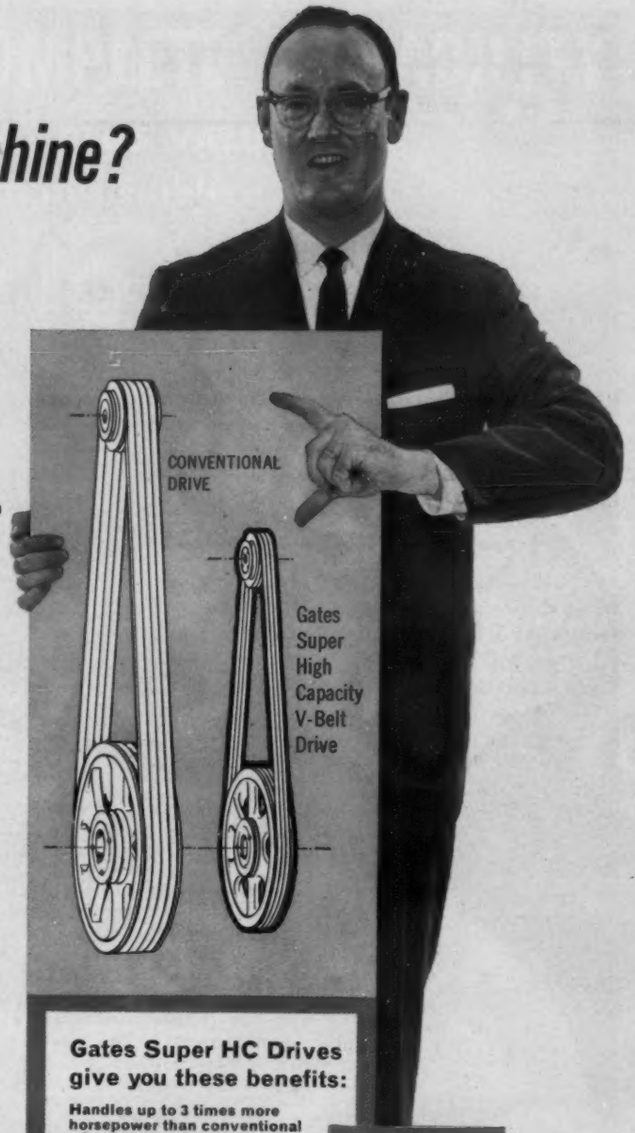
This was accomplished by supplying the drawing as intended under the MIL spec, but with the proprietary legend. When the proprietary legend was removed and competitive bids were secured for the parts, contact was made with the bidders. It was pointed out that the bidder was placing himself in an untenable position by bidding on the manufacture of a patented item. To avoid legal action, which was promised by the off-ended company, the bidders withdrew their bids.

In another case, the military base wanted to remove the legend. The parts involved were off-the-shelf items. Letters were sent to the Adjutant General's Office of the military base, pointing out the violation of rights, copies of the letters were submitted to responsible higher authorities and to each and every member of the Congress. The legend was replaced on the drawings.

These companies stood up and were counted. They utilized the "squeaking wheel approach" and placed their faith in Article II, Section 8 of our Constitution which delegates to Congress the power "to promote the Progress of Science and useful Arts by securing for a limited time to Authors and Inventors the exclusive Right to their respective Writings and Discoveries".

Designing a machine?

Let your local Gates Engineer Prove Super HC Drives save space, weight, money



If you are designing a new machine or redesigning one for better performance, your local Gates Field Engineer will be glad to help you. He can show you how to take full advantage of the many opportunities offered by Gates Super HC High Capacity Drives.

Ask him to design a drive for your machine two ways: a conventional V-belt drive and a new Gates Super HC High Capacity V-Belt Drive. A quick comparison will show you many of the important savings provided by the new Gates drive.

Manufacturers everywhere have standardized upon the Gates Super HC V-Belt Drive—industry's first and most advanced high capacity drive. It is your best assurance that your power transmission unit will not soon become obsolete.

Your local Gates Field Engineer is an experienced, fully-qualified drive design expert. Contact him for drive design help.

The Gates Rubber Company
Denver, Colorado

Gates Super HC Drives give you these benefits:

- Handles up to 3 times more horsepower than conventional V-belts in the same space.
- Saves up to 50% in drive space.
- Reduces drive weight 20% and more.
- Cuts drive costs as much as 20%.
- Reduces bearing load, increasing bearing life.
- Guards and machine housings can be smaller, lighter weight.
- Belt speed up to 6000 ft/min possible without dynamic balancing.
- Less costly, higher speed motors can often be used.

Exclusive design features include:

precisely engineered arched top, concave sidewalls, Flex-Weave cover, super strength tensile construction

Building the future on 50 years of progress

Gates

BP-11

Gates Super HC V-Belt Drives

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DESIGN SPECIAL REPORT NEWS

Rubber Stamps for Mechanical Drawings

Victor W. Wigotsky, Eastern Editor

Rubber stamps often can save mechanical drawing time, especially when machines and component parts must be inserted into a layout. Also, specific equipment can be highlighted easily when a standard line of products is manufactured.

Preparation of Master Drawing

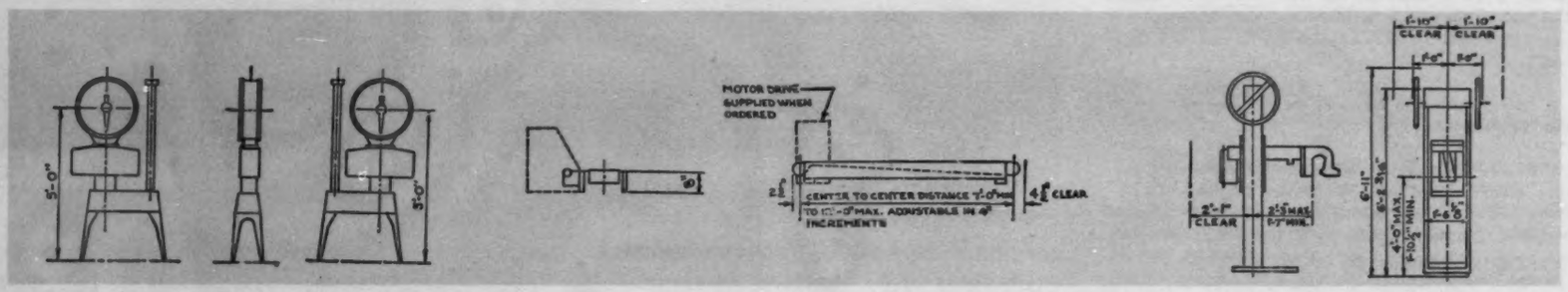
The drawing for making the rubber stamp should be of single line construction, approximately 1/64 inch thick. Minimum spacing between lines should be from 1/32 inch to 3/64 inch thick. Only the most important dimensions should appear on the master drawing. All dimensions should be made in free-hand if the stamp will be used in combination with other free-hand design and lettering on the drawing. Notes pertaining to equipment specifications should not be on the master drawing. These can best be added on the individual drawings after the stamps are applied. Center-lines should not extend more than ¼ inch beyond the last intersecting line. Each master drawing should consist of only one view for any one component to increase versatility. Black india ink on white illustration board or tracing cloth should be used.

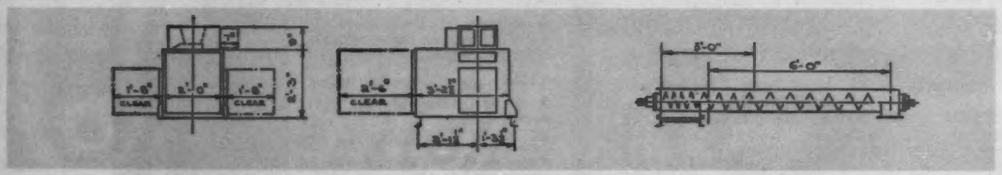
Application Techniques

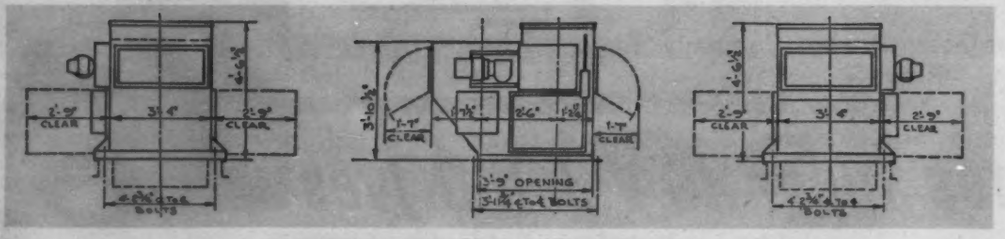
Guide lines placed on top of the stamp and corresponding guide lines on the drawing will assure proper alignment on the layout. Fast-drying, non-smudge, opaque stamping ink will eliminate smearing. An electric eraser eases changes when required.

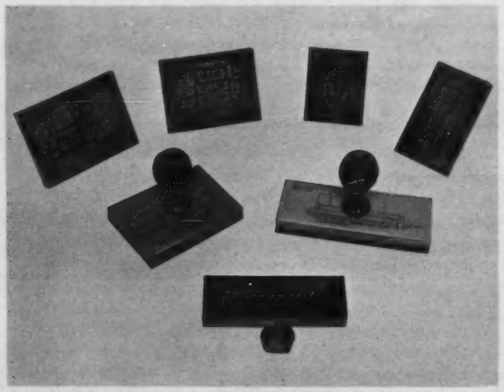
The stamps should be kept in a rack, face down, to prevent dust collection. Periodic cleaning with alcohol and a soft brush avoids buildup of dried ink pigment.

Design information presented in this article was provided by Richardson Scale Co., Clifton, N. J.

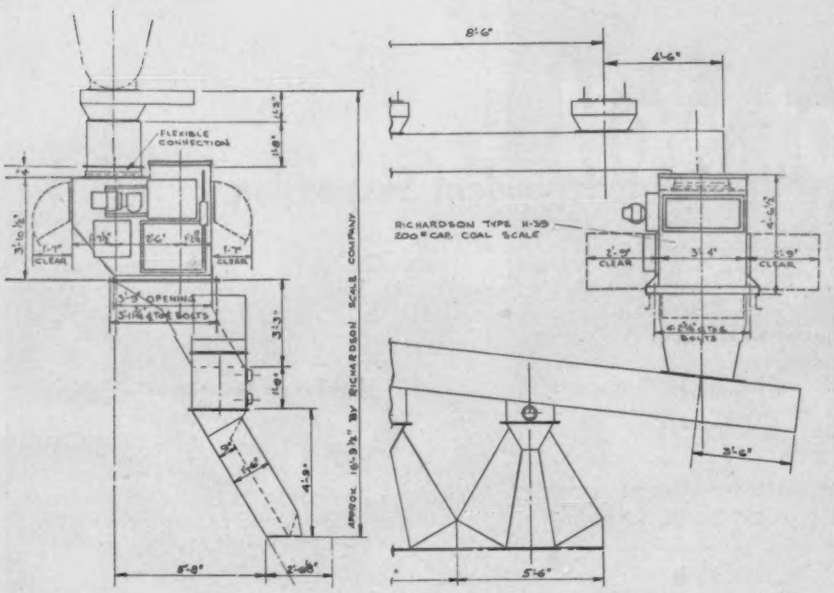




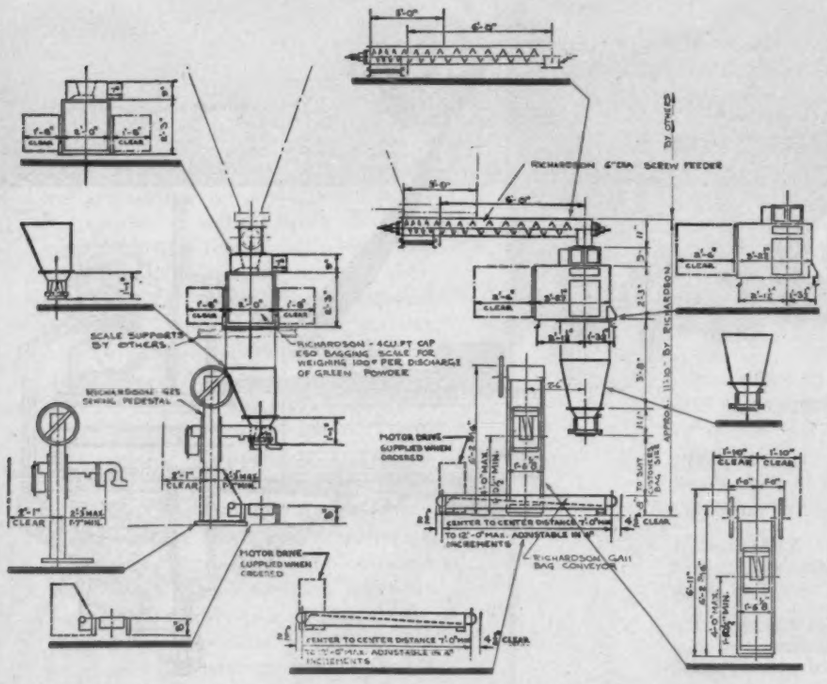




STAMPED ITEMS are interchangeable with other company equipment and can be used in preparation of many drawings.



SINGLE RUBBER STAMP is used to insert coal scale on drawing. Remainder of layout is non-standard. Stamp emphasizes manufacturer's equipment.


RICHARDSON 6" DIA SCREW FEEDER
SCALE SUPPORTS BY OTHERS
RICHARDSON - 4 CU FT CAP E60 BAGGING SCALE FOR WEIGHING 100# PER DISCHARGE OF GREEN POWDER
MOTOR DRIVE SUPPLIED WHEN ORDERED
CENTER TO CENTER DISTANCE 7'-0" MIN. TO 12'-0" MAX. ADJUSTABLE IN 6" INCREMENTS
RICHARDSON GAII BAG CONVEYOR

DRAWING REQUIRED NINE RUBBER STAMPS. Only lettering, dimensions and storage bin are applied free-hand. Less than one-quarter the normal time was required. Stamp cost can be amortized after using a few times. Drawing is prepared in unitized building-block manner. Screw feeder is first placed in position with one horizontal and one vertical guide line. Each stamp is then added through use of additional guide lines.

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COMPLETE RELIABILITY

is the PLUS VALUE with this Emblem... ANCHOR®

THE PLEDGE OF PERFORMANCE

Where threaded-type connectors can be eliminated . . . Anchor's field proven Industrial Hydraulic Flanged Tube, Pipe and Hose Connections, Four Bolt Split-Flange Type make excellent units for connecting (1) hose assemblies to valve or pump parts; (2) hose to manifold; (3) pipe to pipe; (4) pipe to hose; and (5) hose to hose . . . in high, medium and low pressure systems. There are no threads to wear or tapered seats to groove with these Anchor fittings.

Universally accepted by original equipment manufacturers for their *complete reliability* under all operating conditions . . . these Anchor fittings are leak and blow-off proof . . . trouble-free . . . easier to connect or disconnect, especially in tight spaces.

The distinctive Anchor design of Four Bolt Split-Flange Type, Industrial Hydraulic Flanged Tube, Pipe and Hose Connectors eliminates costly pipe threading operations, separate unions and swivel connections, enabling users to disconnect and reconnect hose lines many times without damage or leaks.

Available in flange sizes ranging from ½" to 5".

Write today for Anchor Catalog No. 403 which gives complete specifications.

Andy Anchor says: "Anchor field engineers, near you, can readily show you how you save time and money with Anchor Four Bolt Split-Flange Type Industrial Hydraulic Flanged Tube, Pipe and Hose Connections.

ANCHOR Coupling Co. Inc.

306 North Fourth St., Libertyville, Ill.
Branch Plants: Dallas, Tex., Plymouth, Mich.

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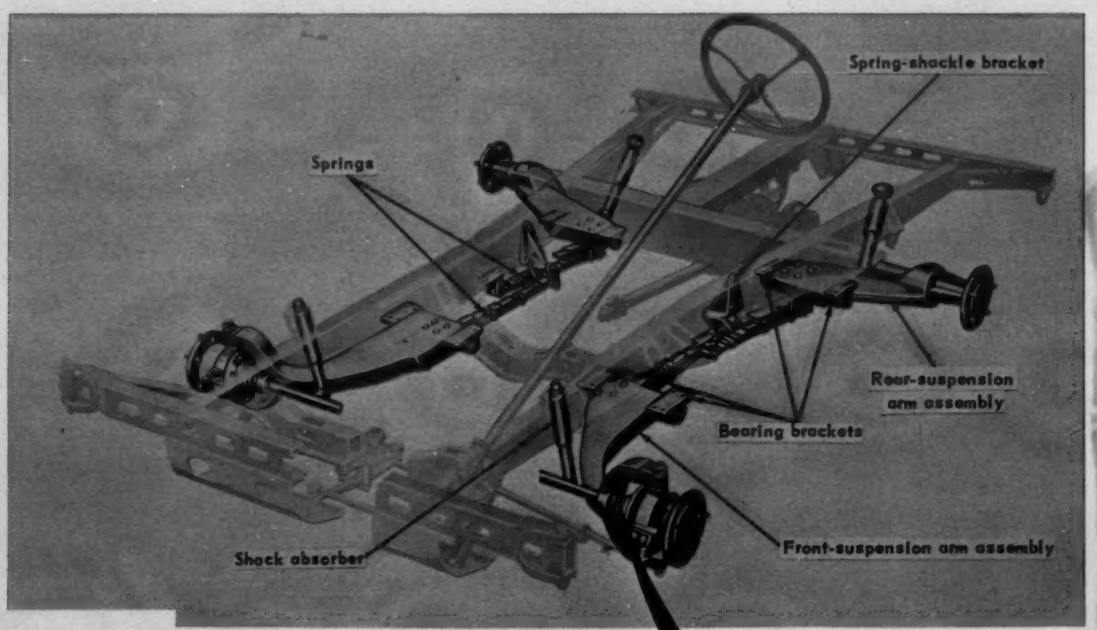
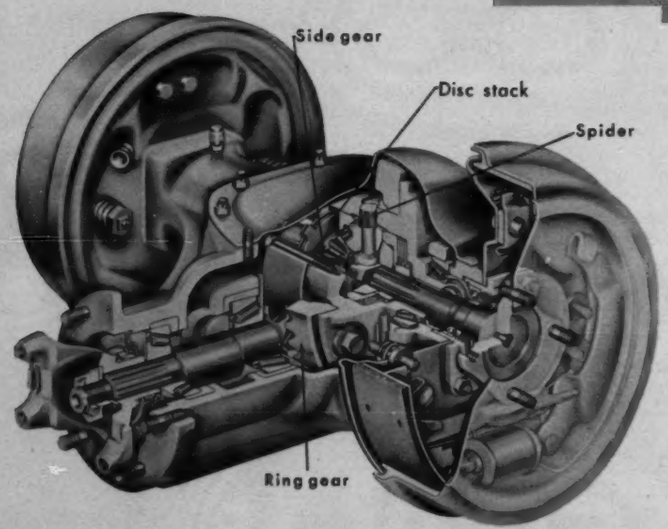
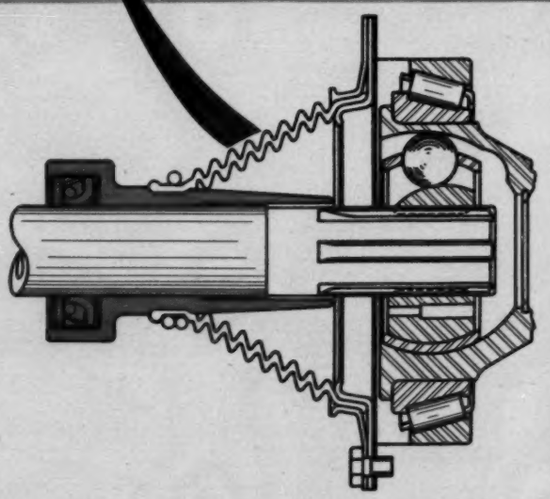
Articulating Arms Give Mighty-Mite Full Independent Suspension

Robert L. Candlish, Detroit Editor







ARTICULATING ARMS of box-type welded-steel construction are mounted on pins rotating in acetal resin bearings. Bearing brackets are mounted to steel frame. Quarter-elliptical springs are cantilever mounted to swing arms and are fastened to shackles amidships. Suspension control is by direct-acting, telescopic-type shock absorbers. Molded "Delrin" plastic part supports inboard end of universal joint protective boot on front wheel universal joints. This replaces die-cast aluminum part used on original design. Extension on plastic part prevents boot from being cut by rotating shaft spline in event boot is struck by obstacle. Low friction coefficient of plastic eliminates need for bearing insert. Body is aluminum; frame is welded steel. Inboard brakes are used on both axles to reduce unsprung weight and remove braking loads from suspension. Frame mounting of differentials eliminates suspension wrap-up on accelerating. Positive-traction mechanisms are used both front and rear.

¼-TON 4 by 4 LIGHTWEIGHT M-422 TACTICAL VEHICLE was developed for Marine Corps "vertical envelopment" operations. Capacity is four persons or two persons plus 500 lb in cross-country operations, pulling trailer loaded with 1000 lb. It can be adapted for mounting 106-mm recoilless rifle. All components are completely waterproof. With little preparation, vehicle can ford completely submerged. Engine is four-cylinder air-cooled with aluminum block, 55 hp at 3600 rpm.

A system of front-leading and rear-trailing articulating arms, quarter-elliptical leaf springs, and direct-acting shock absorbers provides four-wheel independent suspension in the new Marine Corps lightweight tactical truck. The independent suspension keeps all wheels in contact with the ground on rough terrain, providing maximum tractive effort and at the same time reducing shock loads transmitted to vehicle and occupants. Transverse pivoting of suspension arms causes wheels to move vertically with no change in track. Power is transmitted to wheels through double universal-joint halfshafts with splined slip-joints at the outboard end. Ball-type constant-velocity joints are used on outboard ends of front axles. Transfer of suspension forces to rigid center-section of box-type frame side rails causes minimum distortion of frame. The M-422 lightweight tactical vehicle is being built by American Motors Corp., Special Products Div., Detroit, Mich., under contract with the Detroit Ordnance District active for the Marine Corp.

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How to buy a ball valve!

Check these features!

	FLO • BALL	VALVE A	VALVE B	VALVE C	VALVE D	VALVE E
1. TOP ENTRY	√			√		
2. IN-LINE MAINTENANCE	√			√	√	
3. TOP AND BOTTOM GUIDED BALL	√					
4. DOUBLE SEATS	√	√	√	√	√	√
5. FLANGES INTEGRAL WITH BODY	√	√		√		
6. ONE-PIECE BALL AND STEM	√					
7. BLOCK AND BLEED	√					
8. COMPETITIVELY PRICED	√	√	√		√	√

Only FLO·BALL has all 8

In addition to these outstanding features, the **FLO•BALL** valve, with all teflon seats and seals, offers all of these advantages which make it far superior to other types of valves: fast ¼ turn, minimum pressure drop, leakproof shut-off, visible on-off indication, no backlash, and the lowest torque of any valve. The **FLO•BALL** can never stick or freeze, and it lasts longer, with less maintenance, than any other valve made.

HYDROMATICS offers the most complete line of industrial ball valves, including 1" through 14" flanged, 150#, 300# and 600#, all built to ASA dimensions. Also available: ⅛"—2" screwed end valves to 3000#.

HYDROMATICS is the world's most experienced ball valve manufacturer, having built ball valves to 10,000 psi and 14". See your local distributor for details and prices, or write to:

Hydromatics, Inc.

BLOOMFIELD, N. J. • PILGRIM 8-7000 • TWX = BLOOMFIELD, N. J. 120

FLO-BALL

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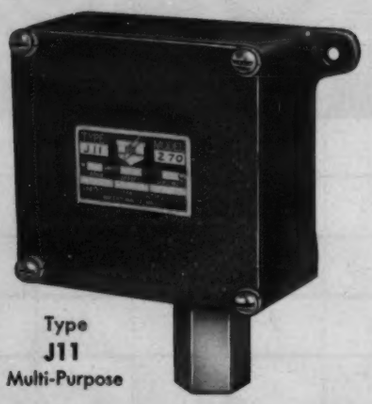
Shock, vibration, and water resistant

PRESSURE CONTROL J11



Type
J11
Multi-Purpose

The Type J11 pressure control is an enclosed, precision built, rugged unit with water and shock resistant features. It is designed for surface mounting, has a cast bronze case, and has steel bearing surfaces and lock washers for applications involving shock or vibration.

Adjustable Pressure Ranges	various models cover ranges between limits of 0 to 600 psi and 0 to 30" Hg, Vac.
Switch Ratings	15 amps or 20 amps at 115 or 230 volts A.C.; D.C., manual reset, high ambient & other switches available upon specification
Switch Types	N.C., N.O., or double throw, no neutral position
Electrical Connections	Screw type terminals on switch are standard
On-Off Switch Differential	Fixed and uniform throughout specified range is standard
Mounting	¼" NPT female, brass fitting is standard
Variations	Design variations are available upon specification
Application	On industrial equipment and engine applications . . . marine, aircraft and special purpose

UNITED ELECTRIC *manufactures a complete line of temperature, pressure, and vacuum controls. For applications requiring custom-built units or modified standard units, call upon a UE application engineer for recommendations. Write for complete specification and pricing data on the Type J11. Similar data available on all other UE controls,*

United Electric Controls COMPANY
85 SCHOOL STREET WATERTOWN MASS

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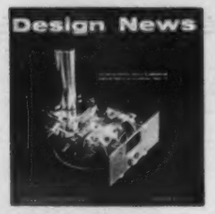


Coil Spring Clutches Give Eight-Millisecond Response to Servo-Actuator

Edward W. Schrader, Western Editor

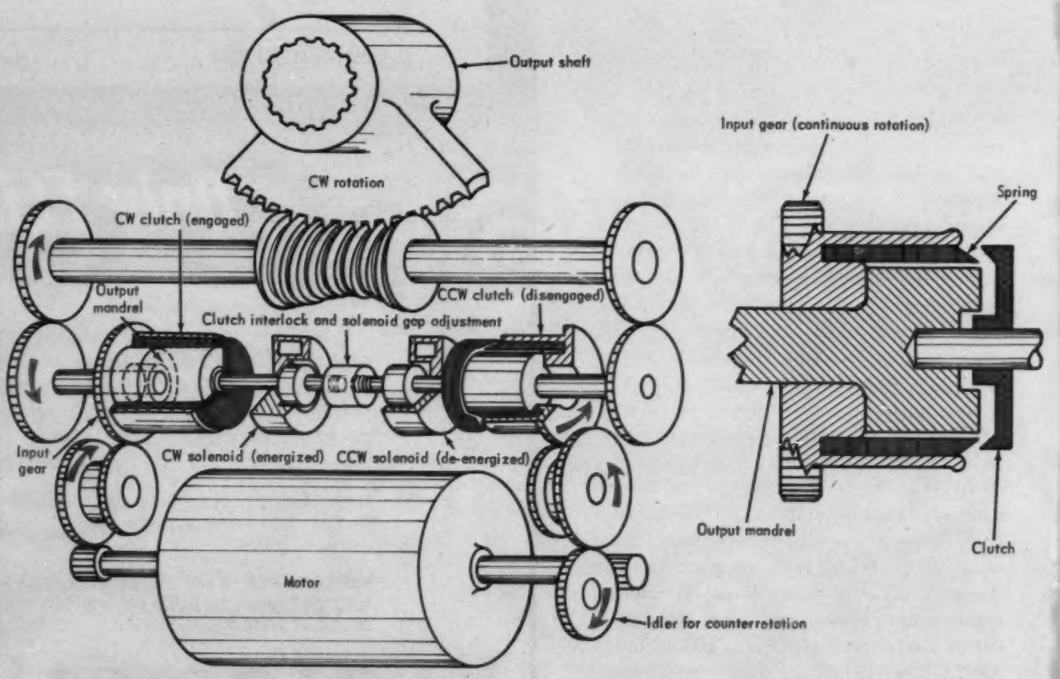
A conical clutch collar moving axially, forces a continuously rotating coil spring to grab its output mandrel for clutch engagement. The servo-actuator uses two unidirectional clutches. One clutch engages for clockwise rotation; the other for counterclockwise rotation.

The driving motor, supplying energy to the system, rotates continuously. Its double-end shaft powers speed-reducing gear trains on either end of the motor; one end includes an idler gear for counter-rotation.

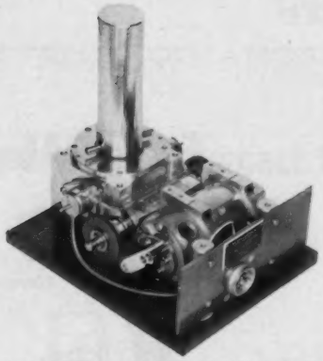
Solenoids actuate either one, but not both, of the clutches to select direction of rotation of output shaft. On triggering, the solenoid armature extends axially for the conical clutch collar to engage the tapered end of the rotating coil spring. The opposite end of the spring is affixed to the input gear train. The angle on the clutch collar converts part of the axial force to a radial force, thus locking the end and the sides of the coil spring to its mandrel. The wedging action on the spring, both radially and axially, transmits torque to the output mandrel.

The final gear pass is a worm and gear, with a small lead angle and an hourglass worm. The worm-gear arrangement gives dynamic braking or self-locking against any external load on the output shaft. There is no reflective loading into the system.

The Electromechanical, Pulsed Servo-Actuator is a design development of American Electronics, Inc., Fullerton, Calif.

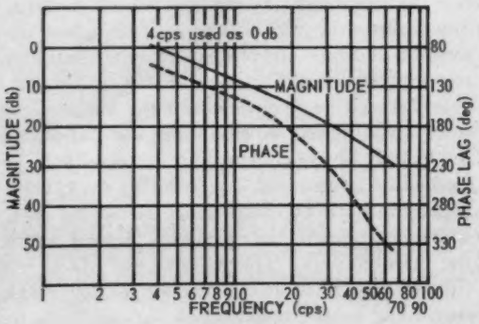


COIL-SPRING CLUTCH achieves high response through continuous rotation, which eliminates time required to overcome static inertia when bringing parts up to rotating speed. Clutch interlock assures engagement of only one solenoid at a time. Thrust loads on worm are supported by tapered roller bearings. Output shaft is capable of full 360-deg CW and CCW rotation with positive lock at any angle when both clutches disengage.

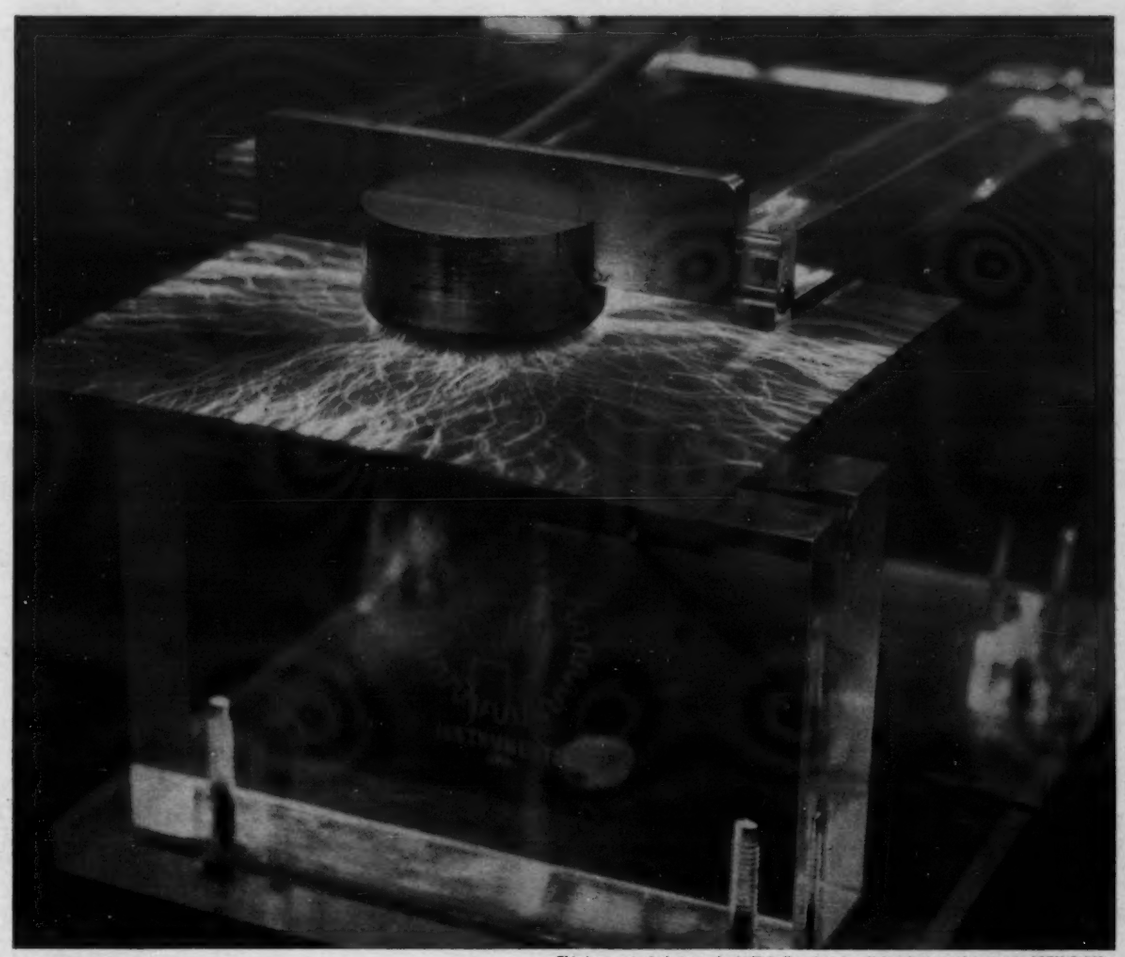


DISPLAY SERVO-ACTUATOR at IRE Show. Output stall torque is 2000 in-lb with 20w, polarized, d-c input signal to control directional actuation. Angular rate is 200 deg per second with 1000 in-lb load. With 1¾-inch dia output shaft, transverse loading is in excess of 5000 lb in shear.

MISSILE FIN powered by pulsed servo-actuator is self-contained plug-in module. Electrical system replaces conventional hydraulic steering system for flight control. Actuator can be stored for long periods of time and cannot be troubled with oil leaks or deteriorating seals.



FREQUENCY RESPONSE to 60 cps. Delay time, from solenoid voltage applied to achieving 100 percent output speed, is 10-millisecond CW rotation and eight-millisecond CCW rotation.



This is an actual photograph of "Mylar" undergoing dielectric strength test (per ASTM-D-149).

MYLAR® has a dielectric strength of 4,000 volts per mil

Can the unique combination of properties found in "Mylar" help you solve your design problems?

High dielectric strength helps cut capacitor size. Tough, thin "Mylar" with a dielectric strength of 4,000 volts per mil for 1 mil film (per ASTM-D-149) permits capacitor manufacturers to reduce size of finished unit . . . improve performance and reliability.

"Mylar"* polyester film is a tough, flexible engineering material. In addition to its outstanding dielectric strength, "Mylar" has an average tensile strength of 20,000 psi, withstands temperature extremes (-60° to 150° C.) . . . resists most chemicals and moisture.

On an area basis, tough, thin "Mylar" often *costs less* than heavier, conventional materials. "Mylar" can be laminated, embossed and metalized, punched or coated. The film won't embrittle with age. "Mylar" is available in roll or sheet form in a wide range of gauges.

Find out how the *combination of properties* in "Mylar" can help you solve knotty design problems, improve product performance or cut costs. Write for our booklet containing detailed information on properties and applications. E. I. du Pont de Nemours & Co. (Inc.), Film Dept., Room P-9, Wilmington 98, Del.

*"*Mylar" *is Du Pont's registered trademark for its brand of polyester film.*

DU PONT
REG. U. S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

DU PONT MYLAR® POLYESTER FILM

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TubeXperience in action

Wind Velocities to Mach 7 Prove Needle-Size Superior Stainless Tubing

Manometer lines of Superior Type 304 stainless tubing, drawn to needle size, withstand the vibration caused by air speeds beyond Mach 7 and internal pressures as high as 5000 psi in FluiDyne wind-tunnel tests of missile component models. And they have been in some assemblies for 3½ years without cracking, pinholing or buckling.

FluiDyne Engineering Corp., one of the major designers of such test facilities, attributes the long life of this Superior tubing to both its high modulus of elasticity and its resistance to the corrosive effects of mercury and soldering-flux acid.

Ductility is a big advantage, too. This permits the Superior tubing to be easily hand-bent into complex shapes for application in wind tunnels and readout equipment.

Filling stainless steel tubing orders that call for tiny needle tubing in gages from 6 to 33 or tubing with OD's as large as 1.125 in. calls for the resources Superior has to offer. Why not investigate us as a source of small-diameter stainless tubing. Catalog 21 describes the types and analyses available. Also gives tips on its selection and application. Superior Tube Company, 2002 Germantown Ave., Norristown, Pa.

Superior Tube

The big name in small tubing

NORRISTOWN, PA.

All analyses .010 in. to ⅜ in. OD—certain analyses in light walls up to 2½ in. OD

West Coast: Pacific Tube Company, Los Angeles, California • FIRST STEEL TUBE MILL IN THE WES

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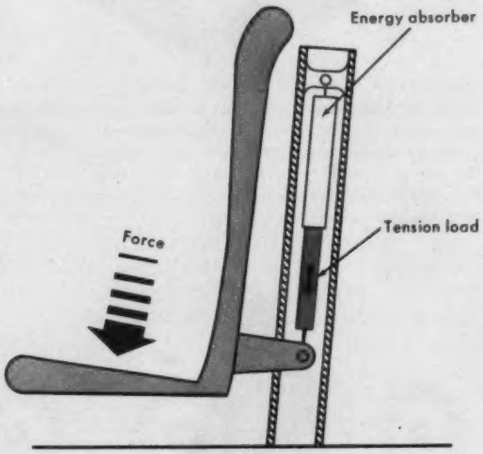
IDEAS . . .

MECHANICAL DEVICES

Energy Absorber

Victor W. Wigotsky, Eastern Editor



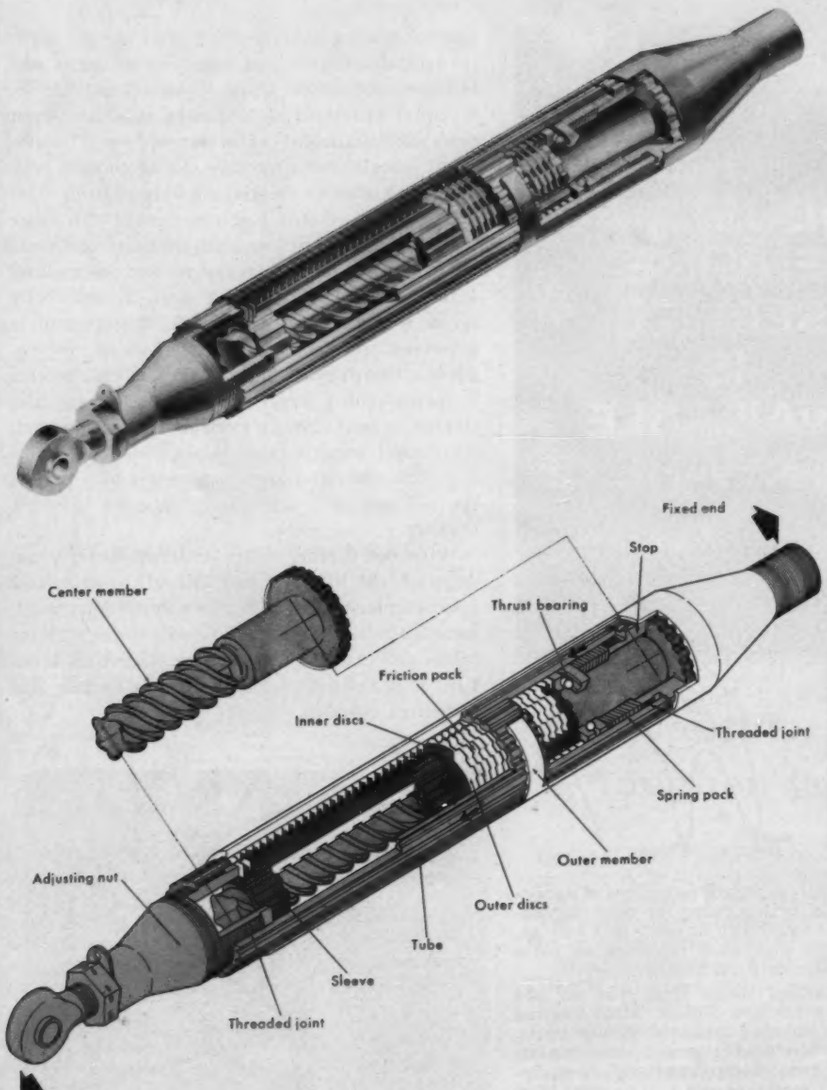
An energy-absorption device in an aircraft seat converts linear motion to rotary motion. Energy is absorbed by the slipping of a multiple-disc friction pack. Unit effectively absorbs a 30G force to maintain a safe G-load on the pilot in event of a flight-deck barrier crash.

Data indicates that the human body, when positioned in a typical high-speed aircraft seat, can safely absorb short-duration shock loadings of approximately 18 G's. Higher loadings, however, can produce vertebral injury. The new device acts as a rigid member at loadings below 18 G's but becomes a pure energy absorber above the 18G threshold. Controlled friction clutches translate the linear seat motion into clutch rotation. This absorbs the impact energy within a short absorption distance and meets the small envelope requirements of the installation.

Device can be removed from the aircraft and reset to its original position for re-use. Calibrated pre-loading of the clutches can be established by mechanical adjustment. Presetting for any G-value is accomplished by compressing the spring pack, which increases or decreases the pressure across the friction pack. The G-value at which the clutches slip is in turn increased or decreased, depending on the preset value.

Unit is incorporated into the aircraft's seat-adjusting mechanism. The energy absorption device (patent pending) was designed by Louis Fuchs, Airborne Accessories Corp., Hillside, N. J.

Converts High-G Impact to Rotary Motion



ADJUSTING NUT, SPLINED TUBE, discs, sleeve, thrust bearing, spring pack and stop form assembly that is straight-splined externally and helically splined internally. With outer member and center member installed, this assembly is locked. At rest, entire pressure of spring pack is reacted through friction pack. Applying tension load moves stop, spring pack and thrust bearing against sleeve. However, to move sleeve axially, it must also rotate due to helical threads mating fixed center member. Outer member, when moving axially, does not rotate. Before motion occurs, inner friction discs must slip between outer discs. Hence, tension load must reach predetermined value before motion (elongation) occurs. No torque reaction is felt externally since action and reaction occur internally. Adjusting nut, tube, friction pack bearing, spring pack and stop react as a unit against sleeve.

Design Uniform lift into equipment with DUFF-NORTON WORM GEAR JACKS

Many designers find a ready answer to precise control of linear motion in machinery or equipment with built-in Duff-Norton Worm Gear Jacks.

They are used singly, in tandem and in multiple jacking arrangements to position loads weighing from a few hundred pounds to as much as several hundred tons.

When connected in tandem or groups of four, six or more, these jacks always raise or lower in exact unison regardless of load distribution. They are also used for application of pressure, to push or pull and as linear actuators.

Duff-Norton Worm Gear Jacks are self-locking and will hold heavy loads in position indefinitely without any creep. Since there is no fluid or air to leak, the action is always positive and maintenance is no problem.

These jacks are available in eight standard models with capacities ranging from 2 to 100 tons and with standard raises from 6 to 24 inches. Special raises can also be furnished.

To learn more about how Duff-Norton Worm Gear Jacks may be used in your equipment, send for the bulletin which shows engineering drawings of jacks, Duff-Norton Mitre Gear Boxes and typical applications. Ask for AD-66DN.

DUFF-NORTON COMPANY

Four Gateway Center • Pittsburgh 22, Pa.

DUFF-NORTON JACKS
Ratchet • Screw
Hydraulic • Worm Gear

DUFF-NORTON

COFFING HOISTS
Ratchet Lever • Air
Hand Chain • Electric

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IDEAS . . .
MECHANICAL DEVICES

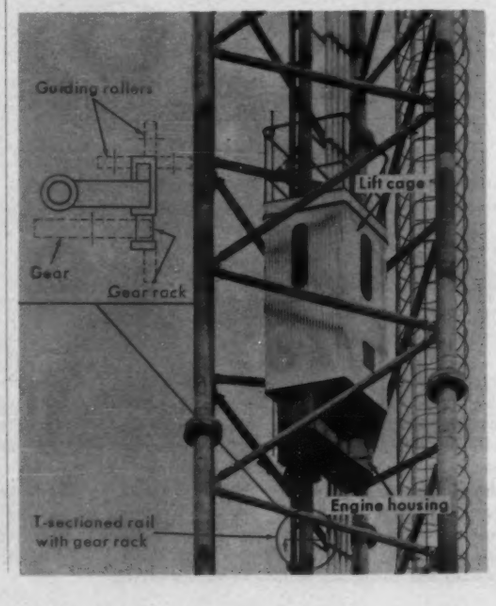
Gear Spacing along Vertical Rack

Volrath Holmboe, Correspondent in Sweden

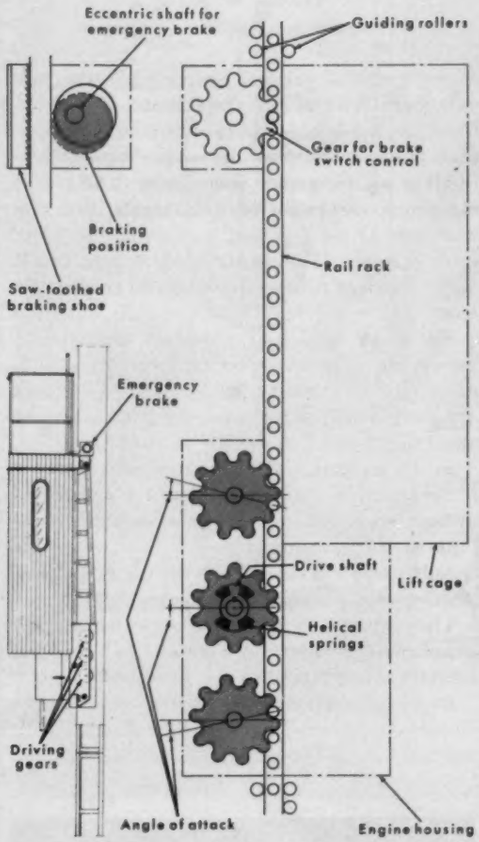
Careful spacing of three drive gears along a vertical rack distributes load evenly to all parts and increases the safety factor of an elevator drive. Unequal simultaneous angles of attack between gears and rack avoid occurrence of "weak" angles in all gears at the same time. Drive to each gear is spring-loaded to absorb rack irregularities. The arrangement permits a robust design with large teeth and results in low stress on gears and rack.

The gears drive an elevator up and down along a rail inside a TV-antenna mast. Round bolts across a channel form the rack. Engagement is preserved through ball-bearing guide rollers, while a fourth gear at the top of the cage rotates a spring-loaded centrifugal regulator for the emergency brake. When a certain rpm is exceeded, centrifugal weights catch hooks inside the housing. This releases an eccentric disc which presses the rail against a saw-toothed shoe for efficient braking.

With the driving motor attached directly underneath the lift cage and with all controls and instruments located inside the cabin, the arrangement forms a complete self-powered unit without cables and external mechanisms. Known as Mast-Lift, it is a development of Alimak-Verken AB, Skelleftea, Sweden.

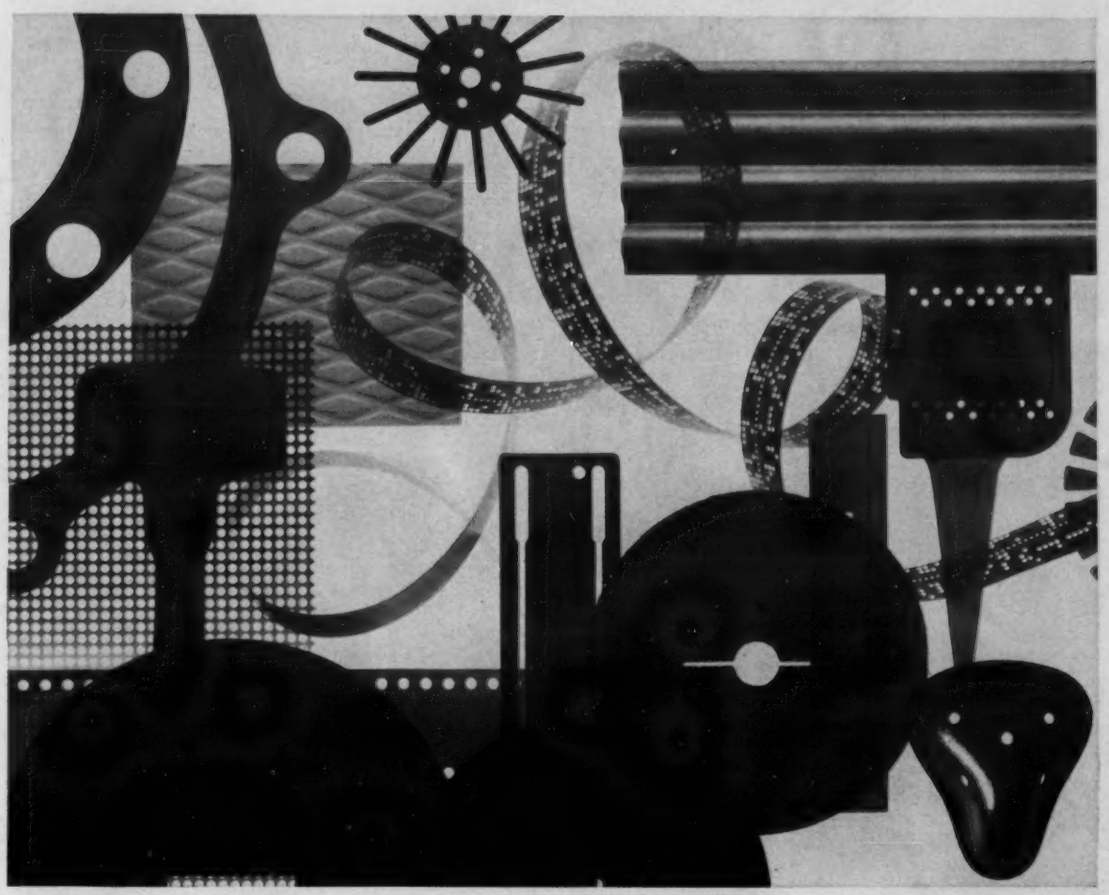


Helps Elevator Load Distribution



UNEQUAL ANGLES of gear attack relative to rack are obtained by spacing gears at uneven multiples of gear pitch. Large transverse force components at large contact angles will take place at different times for each gear. Four internal helical springs permit 3-4-mm rotational movement between each gear and its shaft. Emergency brake consists of eccentric disc and saw-toothed shoe on opposite sides of rail. When centrifugal regulator releases brake, rail is pressed between disc and shoe.

GEAR TRANSMISSION is located in front of engine below lift cage. Each gear is driven by self-locking worm and worm gear. T-sectioned vertical rail carries gear rack and serves as track for guiding rollers for lift cage. Lift consists of steel frame with corrugated aluminum walls. Entrance to cabin is through top door in roof. Limit switch prevents engine from being started unless top door is closed. Maximum load is 500 kg (1100 lb) and lifting speed is 0.3 m/sec (60 ft/min). Lift is driven by two-stroke gasoline engine developing 10 SAE horsepower at 5250 rpm.



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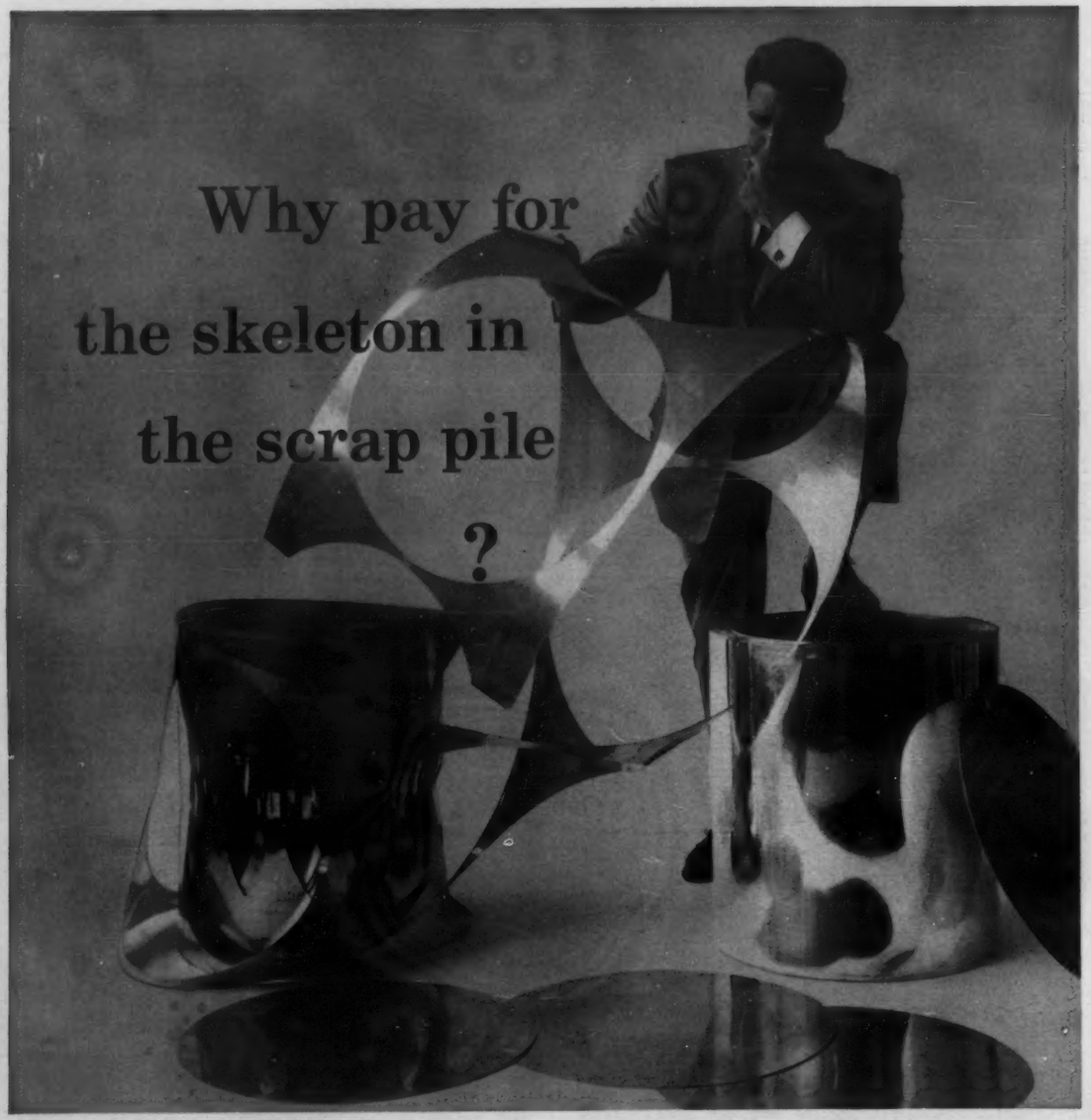

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IDEAS . . .

MECHANICAL DEVICES

Reservoir Vortex Gives Constant Oil Supply in Any Attitude

Edward W. Schrader, Western Editor

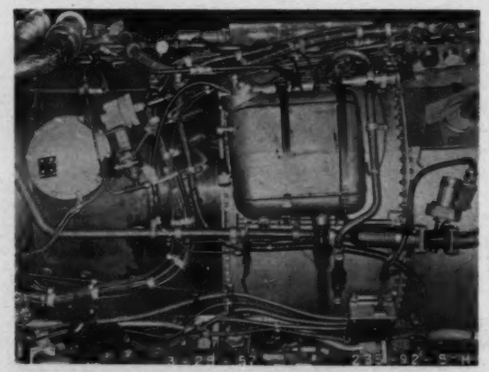
An oil reservoir delivers air-free oil to the constant-speed drive inlet in all attitudes of airplane flight, including negative G conditions. The mixture of oil and air from the constant-speed drive enters a swirl chamber tangentially. The resulting action creates an induced vortex, which is truncated at the top and bottom by the outer swirl chamber. The device feeds 4 gpm of oil under constant flow to the lube and cooling system.

The lower density air, entrained in the entering oil, moves to the center of the vortex as a result of the centrifuging action. Thus, a cylinder of rapidly rotating oil is formed with a core of air at its center.

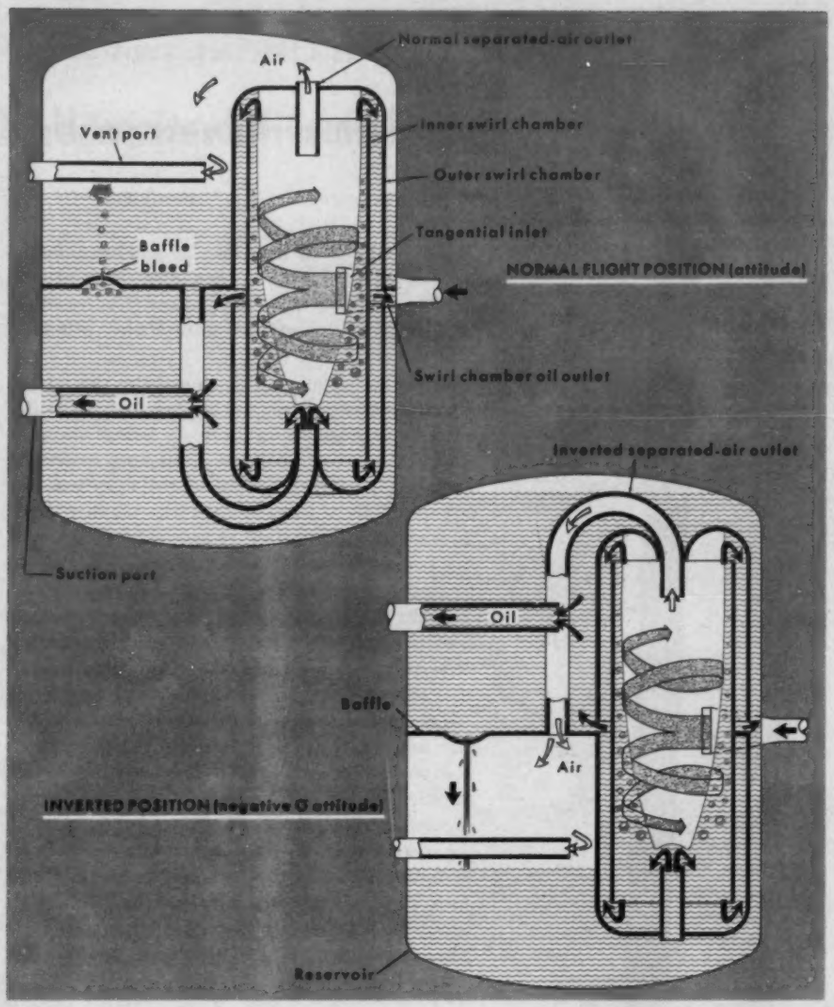
As the incoming oil-air mixture adds more air to the chamber, the air already in the core moves up and out of the swirl chamber. In normal attitude, the air passes through an air outlet into the chamber above a baffle. The air passes through the chamber and out the vent port.

The oil passes to the oil-side of the baffle. This chamber has a lower static pressure as a result of constant oil removal through the suction port.

Bleed holes puncture the baffle separating the oil-side chamber from the air-side chamber. The residual air in the oil on the oil-side chamber



RESERVOIR de-aerates oil in constant-speed drive system. Oil returning to reservoir is highly aerated (35-50 percent air). Flow rate of oil returning to reservoir varies within 70-100 percent. Reservoir delivers constant 4 gpm supply of de-aerated oil (1-5 percent air) to suction line outlet in all attitudes. Reservoir has been used on F100, F106 aircraft and is programmed for secondary power system of B-70 supersonic bomber.



passes through these bleed holes to reach the air-side of the baffle.

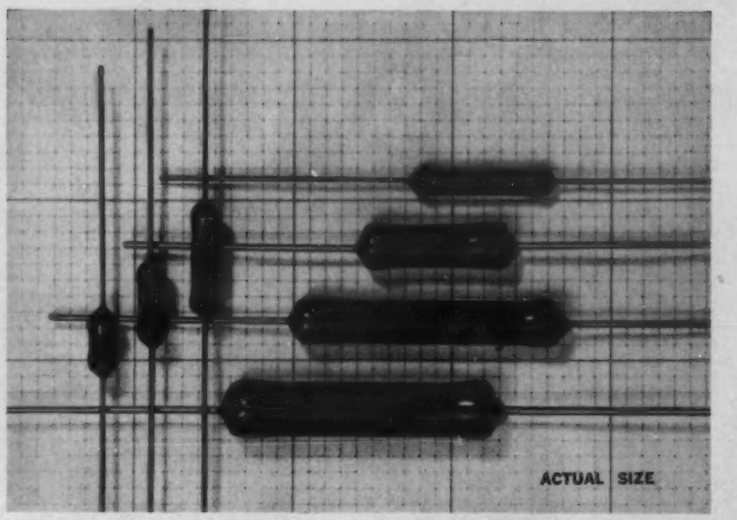
The inverted separated-air outlet indirectly assists in removal of residual air. In normal flight attitudes, the outlet is submerged under a static head of oil. Oil flows down the outlet tube in an auxiliary circuit and into the bottom of the swirl chamber. Here it is again entrained in the vortex and is pumped through the oil outlet, packing the oil-side of the chamber. It fountains up through the bleed holes, carrying the residual air with it.

During inverted, or negative G, operation of the reservoir, the performance of the de-aeration cycle remains largely unchanged. The air-oil mixture enters the inner swirl chamber at high velocity. The mixture swirls, de-aerates and floods over both ends of the inner swirl chamber. As air-free oil, it is pumped to the oil-side of the baffle through the outlet.

When the reservoir operates on its side or in any other intermediate attitude, performance is essentially the same. The air leaves the vortex by one of the two outlets which offers the least resistance. The oil enters the swirl chamber to be pumped to the oil-side through the other outlet.

The inner-outer swirl chamber design maintains a constant mean flow path for the oil between the tangential inlet to swirl chamber and the swirl chamber oil outlet. Thus, the design gives nearly uniform de-aeration in all reservoir attitudes.

The oil reservoir is a patent-pending design development of North American Aviation, Inc.



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		Min.	Max.	Length*	Diam.
2	2X	0.1	5,000	3/8	3/16
3	3X	0.1	10,000	1/2	3/16
4	4X	0.1	15,000	11/16	3/16
5	5XM	0.1	20,000	13/16	3/16
7	7X	0.1	25,000	1	3/16
10	10XM	0.1	50,000	1 3/4	5/16
12.5	12.5X	0.1	75,000	1 3/4	3/8

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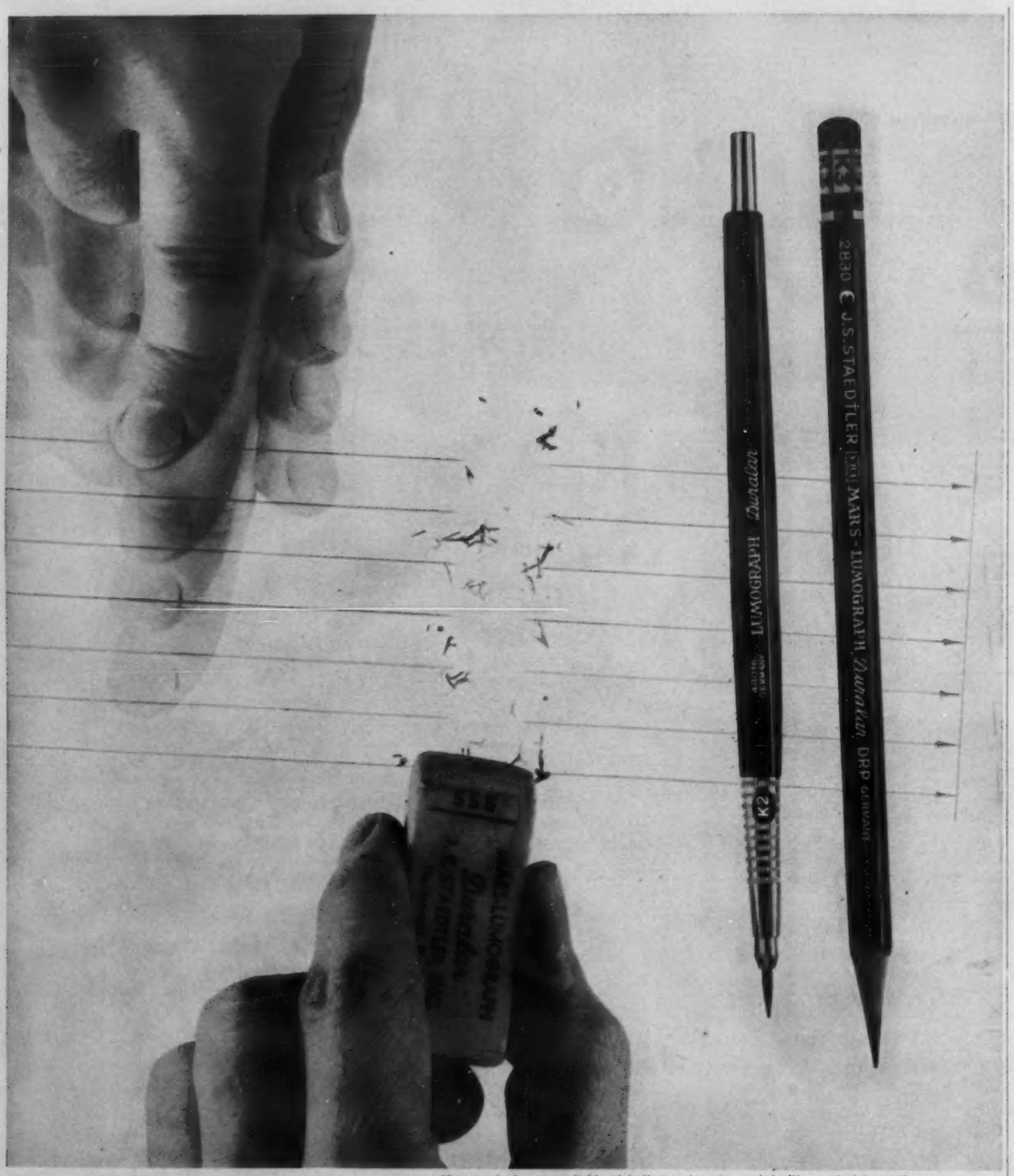

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IDEAS . . .

MECHANICAL DEVICES

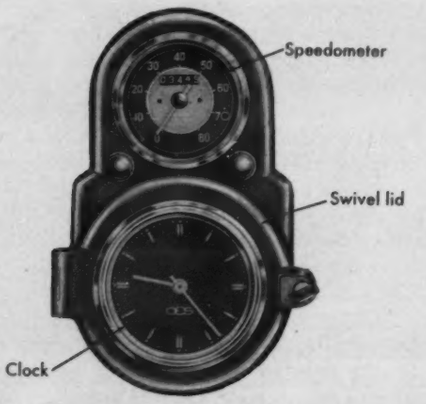
Normal Vibrations Help

Celestino O. Lubatti, Italian Editor

Normal vibrations in a moving car are used to lift and drop a speed recorder's pen. Intermittent pen contact with the waxed record disc considerably reduces drive torque requirements, produces neat dotted lines.

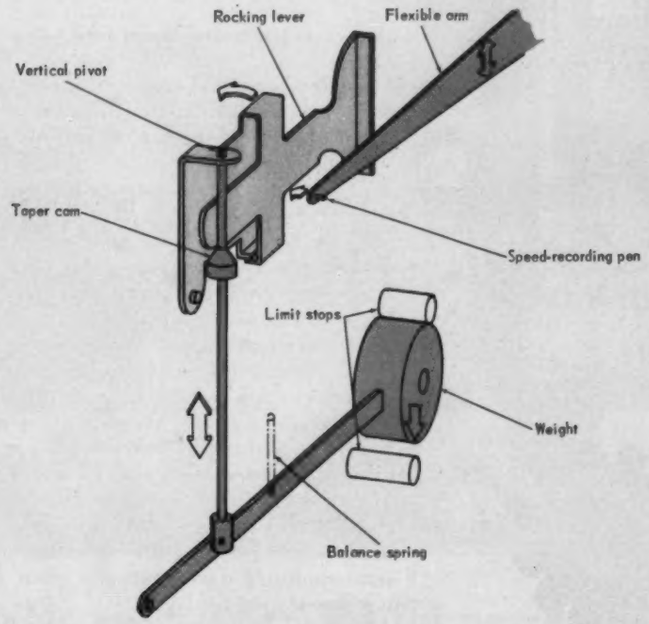
A spring-suspended arm, pivoted to the instrument frame at one end and having a weight at the other, responds to vibrations. It swings through a vertical arc between close limit-stops in accord with frequency of car vibration. A taper cam reciprocated by this assembly rocks another lever through a small horizontal arc to lift and lower the pen alternately. Simultaneously, the speedometer shaft varies the radial position of the pen over the record disc to indicate speed changes. Low friction of the sector gear and toggle lever drive permits use of the very small torque available on the speedometer shaft.

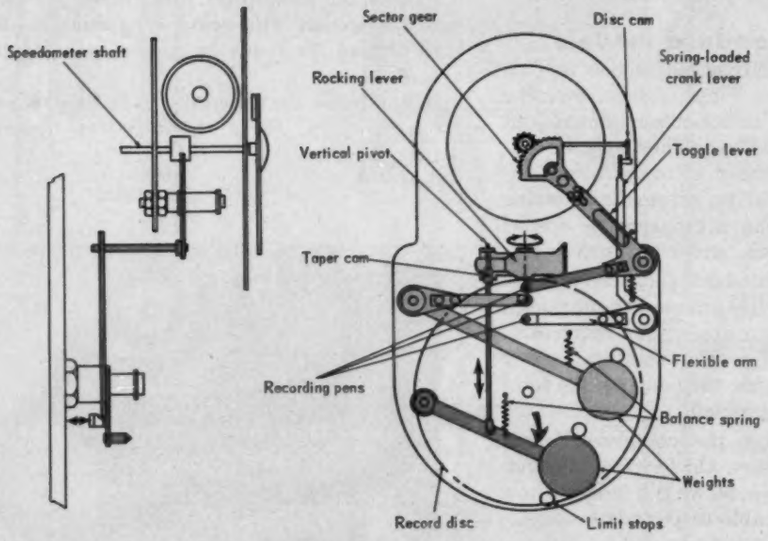
Two additional pens record, respectively, engine hours and distance covered by the car. A vibration-sensing arm, similar to that of the speed recorder, swings the intermediate pen to indicate engine-running periods. The integrating gear of the speedometer actuates the distance record pen by means of a disc-cam bearing against a crank lever. The various drives are located behind a swivel lid housing the clock and the record disc. The instrument was designed by E. Boselli SpA, Milan, Italy.



INTERMITTENTLY LIFTED PEN of speed recorder is driven by speedometer shaft to avoid complex mounting for separate drive. Additional pens indicate engine-running periods and distance covered by car. Clock on swivel lid rotates waxed record disc.

Speedometer Drive Recording Stylus





CAR VIBRATION causes oscillation of spring-suspended weights belonging respectively to speed recorder and indicator of engine-running periods. Speed-recorder weight reciprocates taper cam. Rocking lever turns about vertical pivot to lift and lower pen alternately. Balance spring holds weight and keeps pen in contact with record disc when no vibration occurs. Vibrations drop weight and taper cam, allowing flexible arm to spring back and lift pen. Sector gear rotated by speedometer shaft swings toggle lever carrying flexible arm. Intermittent pen contact with record disc considerably reduces power absorption for diagram plotting. Disc cam rotated by integrating gear (not shown) presses spring-loaded crank to move distance record pen.

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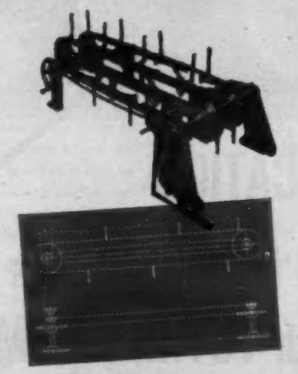

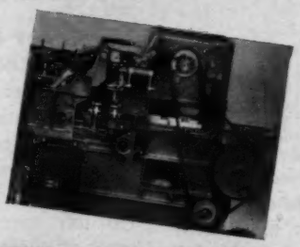

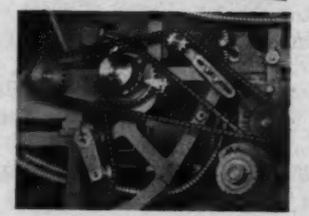

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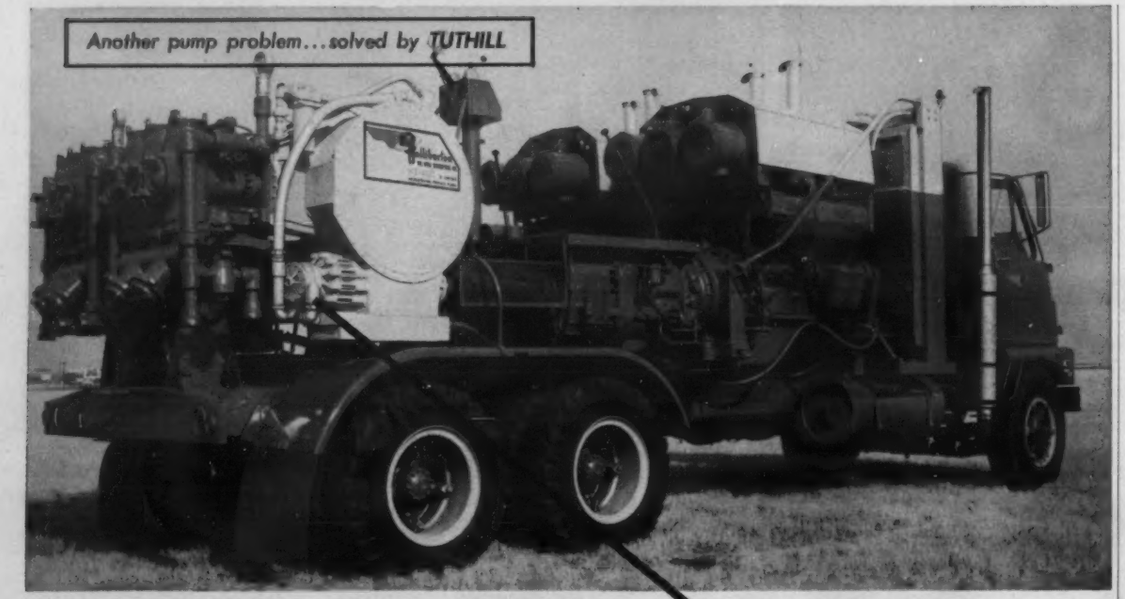
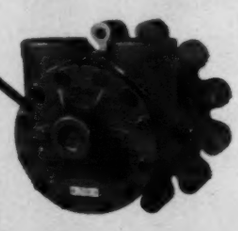


POSITIVE LUBRICATION of Halliburton "fracturing" units with TUTHILL PUMPS



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Over 800 standard models

This model 6C is one of over 800 models in Tuthill's complete selection. These include reversing pumps, special pump motor-combinations, and stripped units for OEM use. They may be furnished with a wide variety of modifications including built-in relief valves, automatic reversing feature, special porting arrangements, special seals or shaft extensions, and many more.

Probably a Tuthill standard model can provide an economical, dependable answer to your pumping problem. But if your application requires it, Tuthill's engineers will develop modifications or special features to provide the best possible solution to your pumping problem.

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IDEAS . . .

MECHANICAL DEVICES

Pivoted Beam Frame

E. J. Stefanides, Central States Editor

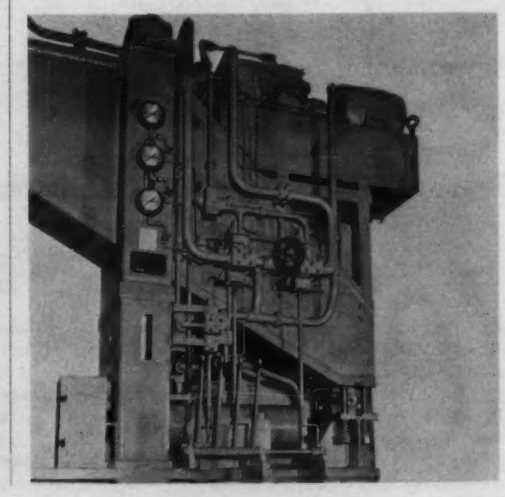
An unusual design of fabricated frame for open-gap presses uses two fabricated beams pivoted at one end and held together by shrunken tierods and a beam spacer.

This design effects a material savings and provides heavy sections where needed. It also eliminates the need for difficult, small-radius bending of heavy plates at the throat of the frame. Another advantage over the conventional open-gap "c" frame fabricated construction is that all stresses are definitely predictable simple stresses.

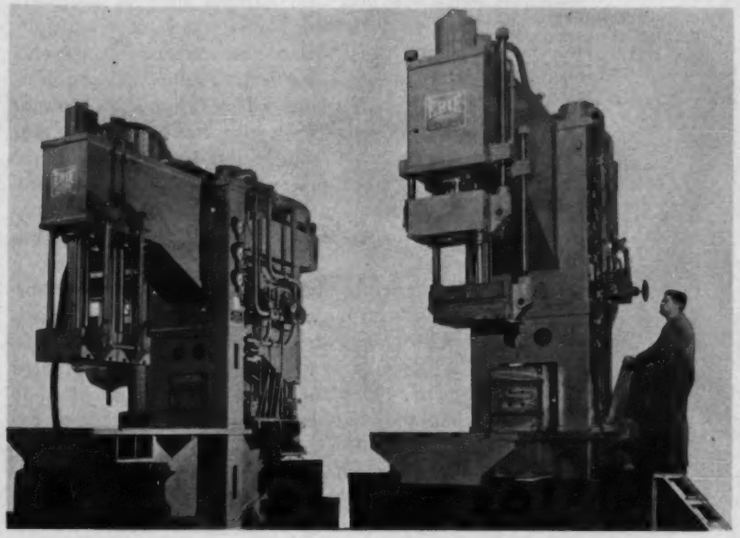
The upper and lower beams are of fabricated box construction and are joined at the pivot end by a compression pin assembly. This assembly consists of two cast steel, compression pin support halves and a compression pin. One half is attached to each of the beams and bears on the compression pin. Four spring-loaded bolts hold the two halves together. Spring loading of the bolts prevents rupturing during rebound when the load is removed suddenly.

Two tierods are used, one on each side of the frame at the beam spacer, which is also a fabricated box section. The tierods are shrunk in place to preload the frame in opposition to applied load.

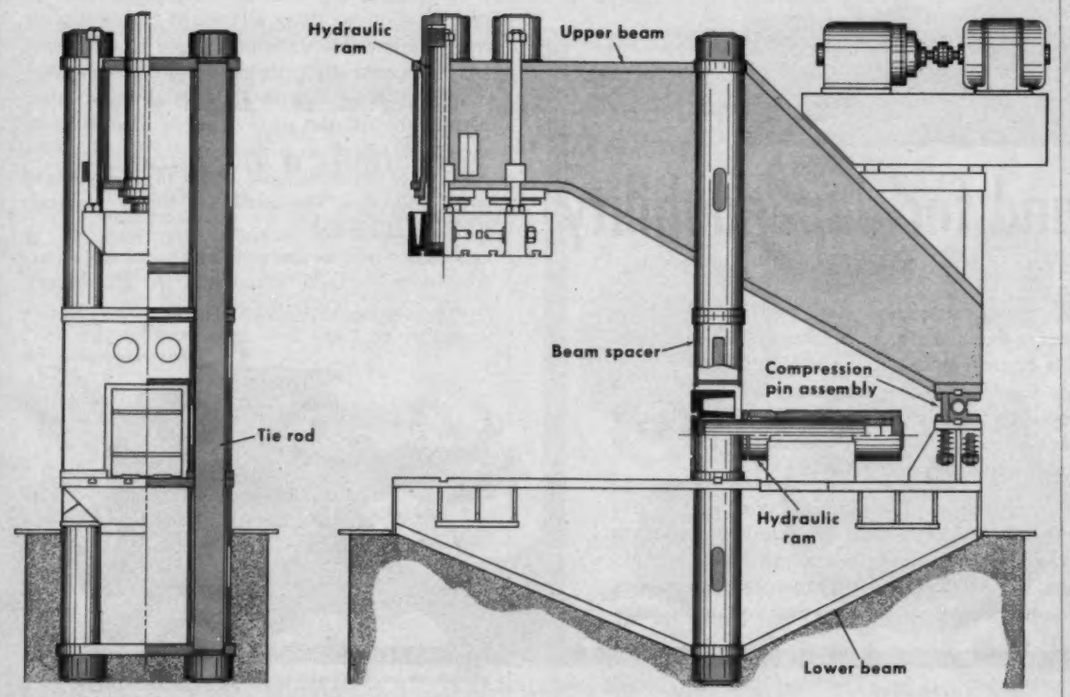
This frame was designed by The Erie Foundry Co., Erie, Pa., for a recent 200-ton hydraulic flanging press.



Simplifies Stress Prediction, Frame Fabrication



200-TON HYDRAULIC FLANGING PRESS vertical rams are each of 100-ton capacity. Press at left has vertical rams keyed together to act in unison. Rams of press at right are controlled independently for separate action. Horizontal ram is also of 100-ton capacity.



FRAME consists of upper and lower fabricated beams pivoted at one end and held together by box section spacer and shrunken tierods. Design is particularly suitable for large-capacity, open-gap machines since it eliminates small radius bending of heavy plates at throat.

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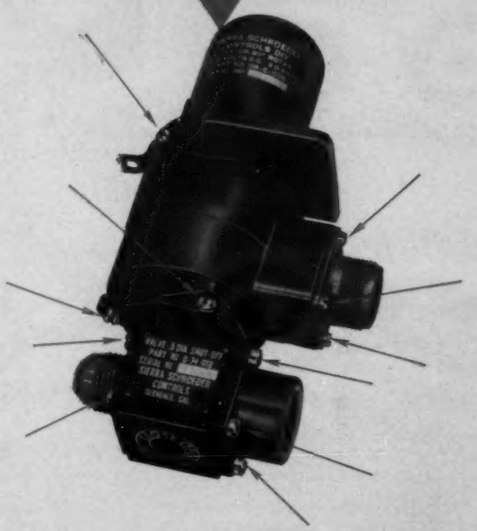
SIMPLIFY ASSEMBLY AND FIELD SERVICE ON THIS MOTOR OPERATED SHUT-OFF VALVE



Use of Long-Lok Self-Locking Screws on this Sierra-Schroeder Controls Model 74-01B Valve eliminated lock wire, provided repeated re-use—simplified field service. Long-Lok Self-Locking Screws are used on the housing of this valve as well as on the gear train mounting where an extremely restricted assembly area makes the use of lock wire a time consuming and prohibitively expensive operation.

Long-Lok Self-Locking Screws can speed and improve your assembly operations—provide important savings in time and labor—assure highest reliability.

Available in all head sizes and styles—have wide temperature range—qualified to MIL-F 18240 specifications—head marked for self-lock identification.

If you have a fastener problem, Long-Lok can help you.

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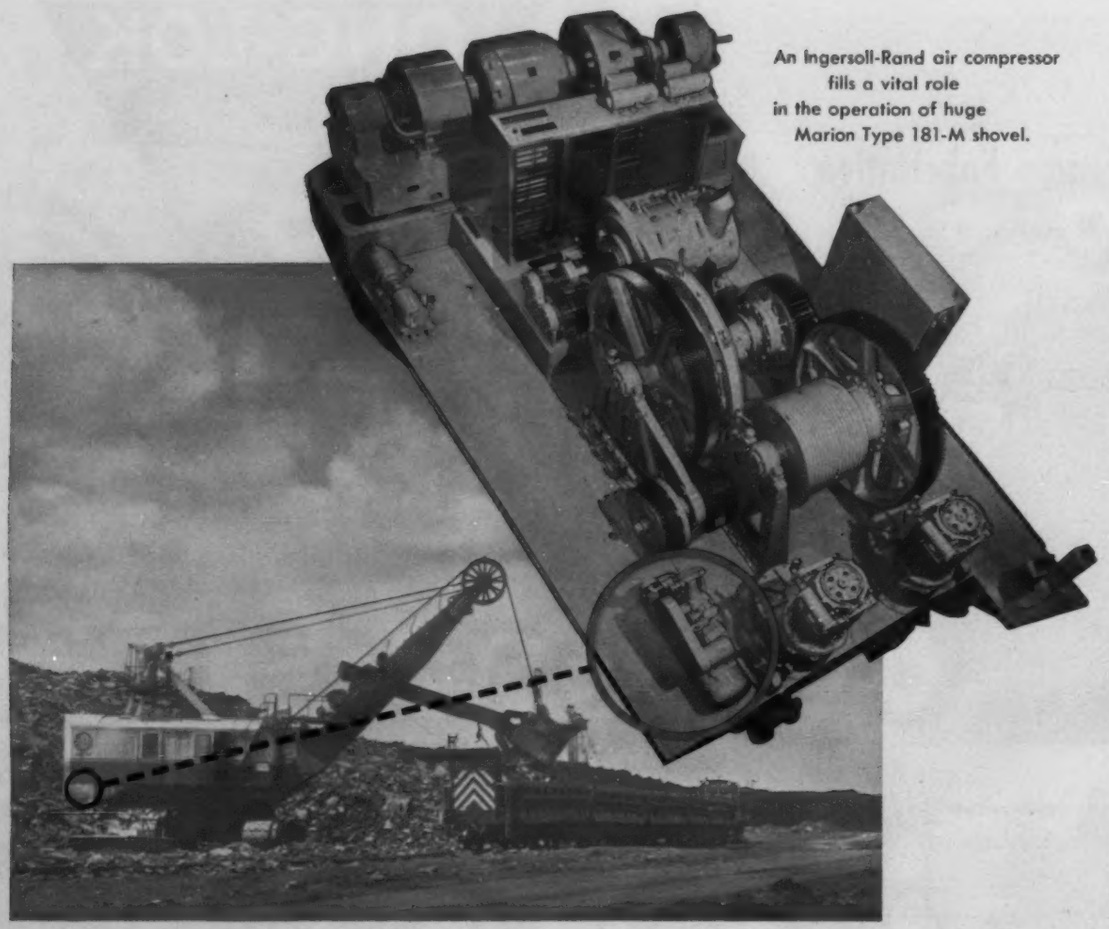

An Ingersoll-Rand air compressor fills a vital role in the operation of huge Marion Type 181-M shovel.

design with Ingersoll-Rand for dependability

Get complete details from your Ingersoll-Rand representative or write for catalog data.

147A3

Equipment designers and product engineers can match their most rigid specifications from this *complete* line of Ingersoll-Rand air-cooled air compressors. Top efficiency and operational economy plus important savings in space and weight make I-R compressors the top choice for dependable components.

Ingersoll-Rand air-cooled air compressors are available as bare units, baseplate mounted or tank mounted in sizes ½ through 20 hp. In addition, I-R can furnish high pressure compressors, non-lubricated compressors and vacuum pumps.

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IDEAS . . .

MECHANICAL DEVICES

Floating Sun Gear and Annulus

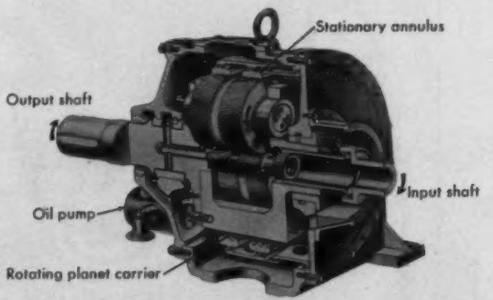
J. H. van Grondelle, Correspondent in Holland

Both sun gear and annulus float to distribute load evenly among planet wheels of a multiple-planet epicyclic helical-gear transmission. Depending on the ratio between annulus and sun gear, three or more planet wheels are used to transmit power. In comparison with simple planetary gear transmissions at similar gear loads, at least three times as much power can be transmitted. Additional advantages are lower gear speeds, reduced friction losses, smaller deflection of shafts and less weight.

A prerequisite for top efficiency in power transmission with multiple epicytlic gear reductions is that all planet wheels must be loaded equally. In this design, the two-part sun gear is supported only by the planet wheels and adjusts itself to equalize radial components of forces from the planet wheels. Axial components between the dual units are equalized automatically because a double gear-type coupling between sun gear and driving shaft permits axial displacement freely.

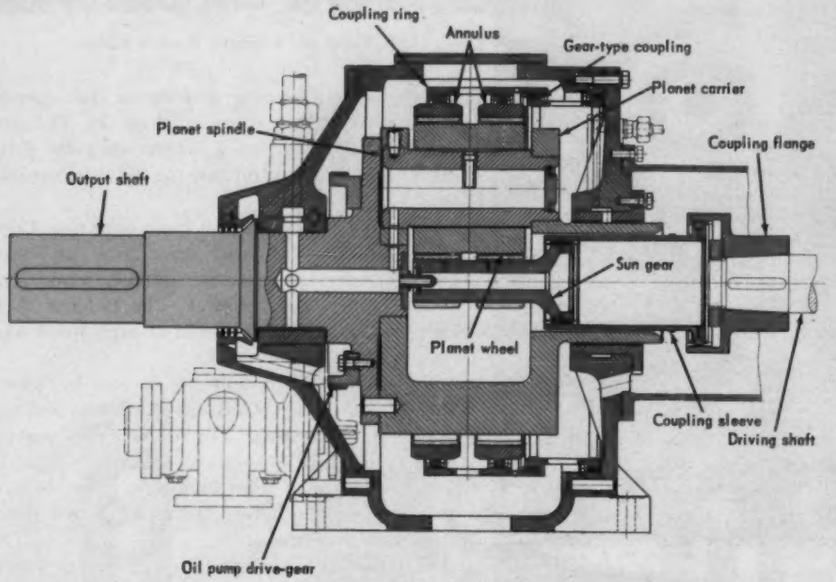
Comprising two internal ring gears with opposed helical toothing connected to a coupling ring, the annulus transmits torque to the casing (or the output shaft) through a double gear-type coupling. Being free to slide axially, the latter permits the annulus rings to adjust themselves on the planet wheels so as to divide the load equally. Absence of axial forces on either input or output shaft eliminates the need for thrust bearings, boosting efficiency.

The design was invented by Dipl. Ing. Stoeckicht, Munich, and manufacturers are Messrs. Krupp, Essen, Western Germany.



EPICYCLIC GEAR TRANSMISSION model with rotating planet carrier. Lubricating pump driven by low-speed shaft is optional, as is hydraulic clutch between annulus and gearcase (not shown). Transmissions are available in various sizes up to 20,000 hp, with ratios from 2:1 to 12:1, and speeds from 250 to 3000 rpm (low-speed shaft). Multistage transmissions have ratios up to 100:1.

Equalize Load Distribution in Epicyclic Transmission



HIGH-SPEED INPUT drives sun gear through two gear couplings. Planet wheels rotate and meshing with stationary annulus forces planet carrier (rigidly connected to low-speed output shaft) to rotate. In another model, planet carrier is held stationary in casing, planet wheels working only as intermediate gears between fast-running sun gear and annulus rings connected to output shaft through gear coupling.

THE AMPLEXOLOGIST

dreams up a gear train

The Amplexologist designed this gear train (plus ten other parts) especially for powder metal production—at the request of a manufacturer who called him in at the design stage. All (except the helical gear) are finished precision parts which require only shaving. Estimated savings; 86%. Sound interesting? Call the Amplexologist.

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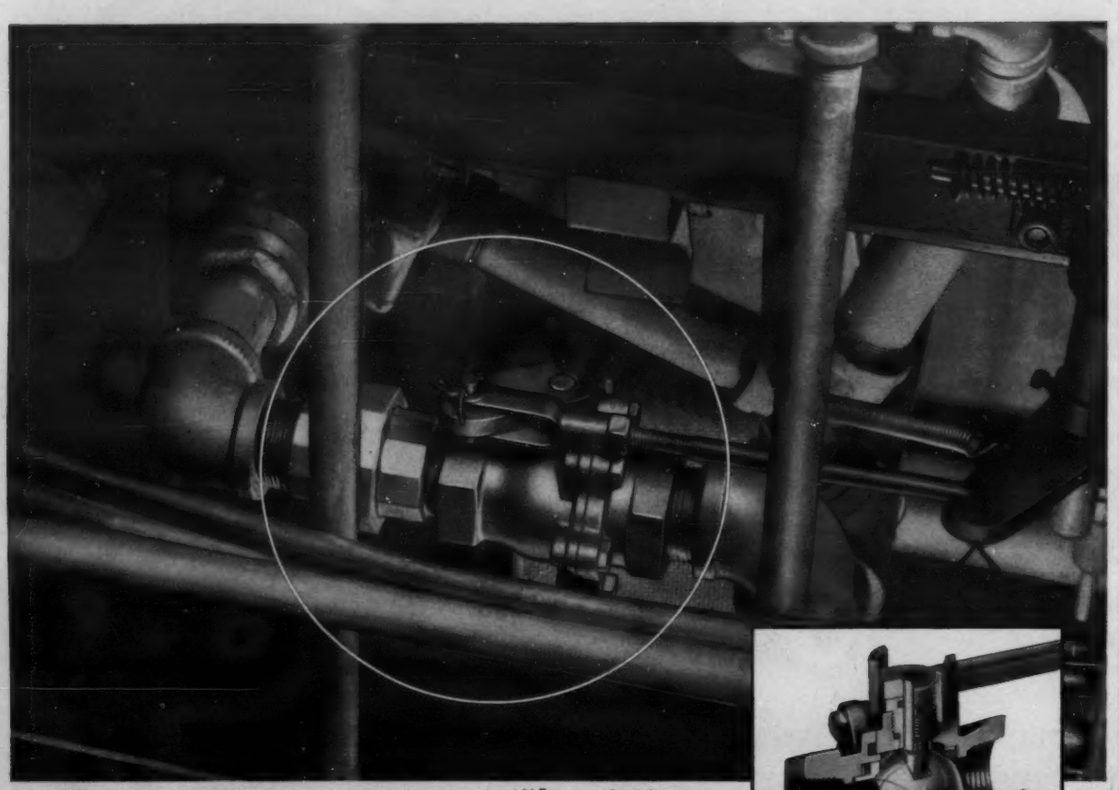
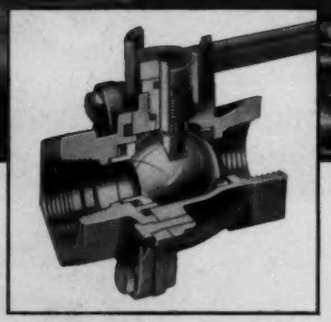
CLEANLINESS COUNTS *in big, fast can washer*



One of the Rockwood Bronze Ball Valves used on cleansing line — size 1¼" — in a *Straightaway* Can Washer built by the R. G. Wright Co., Inc., Buffalo, N. Y., for milk companies and other users.



ROCKWOOD Ball Valves simplify operation and maintenance

In *Straightaway* Can Washers Rockwood Ball Valves are used for washing with a detergent solution and rinsing with sterile water, at temperatures of 135°F. to 180°F. Aid in processing up to 15 large cans per minute, in preventing seepage of wash solution into mechanism and in reducing maintenance to minimum are provided by these Rockwood Ball Valve advantages:

Full Round Flow. No change in shape or volume of fluid stream — no turbulence — minimum loss.

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Quick Opening and Closing. Only a quarter turn needed.

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Rockwood Ball Valve sizes run from ⅜" to 2" in bronze and up to 10" in cast steel. Equipment manufacturers and processing plants depend on them for proved full round flow and protection of product and performance in the widest range of processing. Tested and listed by Underwriters' Laboratories, Inc. Write today for full information. ROCKWOOD SPRINKLER COMPANY, A Division of The Gamewell Company, A Subsidiary of E. W. Bliss Company, 849 Harlow Street, Worcester 5, Massachusetts. Distributors in all principal industrial areas.

ROCKWOOD BALL VALVES

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IDEAS . . .
MECHANICAL DEVICES

Power Tool Uses 'Push'

Victor W. Wigotsky, Eastern Editor

A new power fastening tool uses a slow, steady push rather than a sharp acceleration. The piston-drive tool provides a booster-assist for driving fasteners into concrete or mild structural steel.

Improved safety was the basic objective. Conventional power-actuated drive tools or "stud guns" rapidly accelerate the fastener away from the surface of the material. The fastener then initially contacts the material at high speed and considerable impact shock.

In the new design, power is derived by "pushing" a heavy mass (consisting of a piston and the fastener) at low speed. The fastener is in contact with the work at zero velocity when entry is made into the material. This eliminates possible hazards, such as ricocheting, fishhooking, over-penetration or explosive spall.

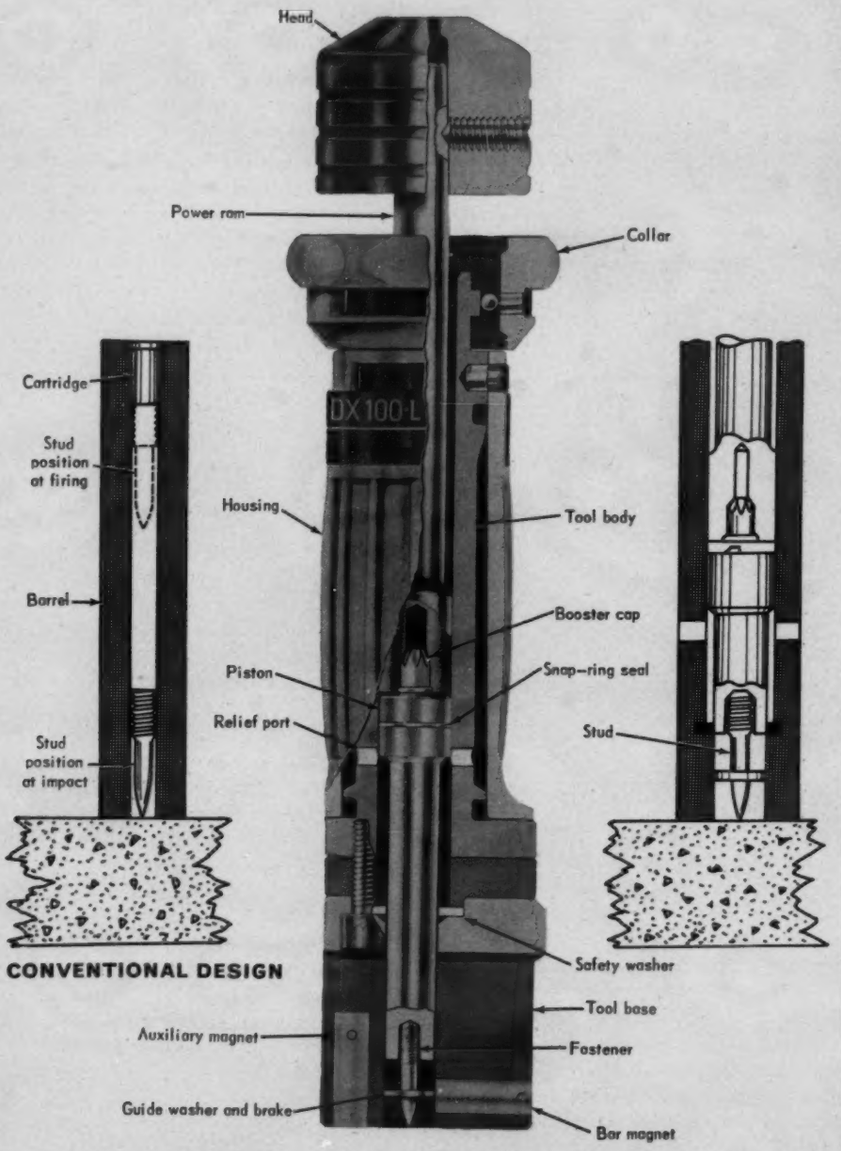
Unit is basically a hand-drive tool with a split ram. The bottom portion surrounds the head of the fastener and can extend ⅜ inch beyond the tool base. Upper portion of the ram includes a heavy head and a recess in its lower end to hold a slow-burning, rim-fire booster cap. A hammer blow on the head causes firing of the booster cap and results in a steady application of force on the fastener.

The tool base rests on the material during the entire cycle; the low-velocity operation assures safety during installation. Fasteners are provided with a washer, additionally preventing over-penetration if a low-resistance area is encountered in the material.

The Model DX-100L power piston drive tool was designed by Hilti, Inc., Rapid Fastening Systems, Stamford, Conn.

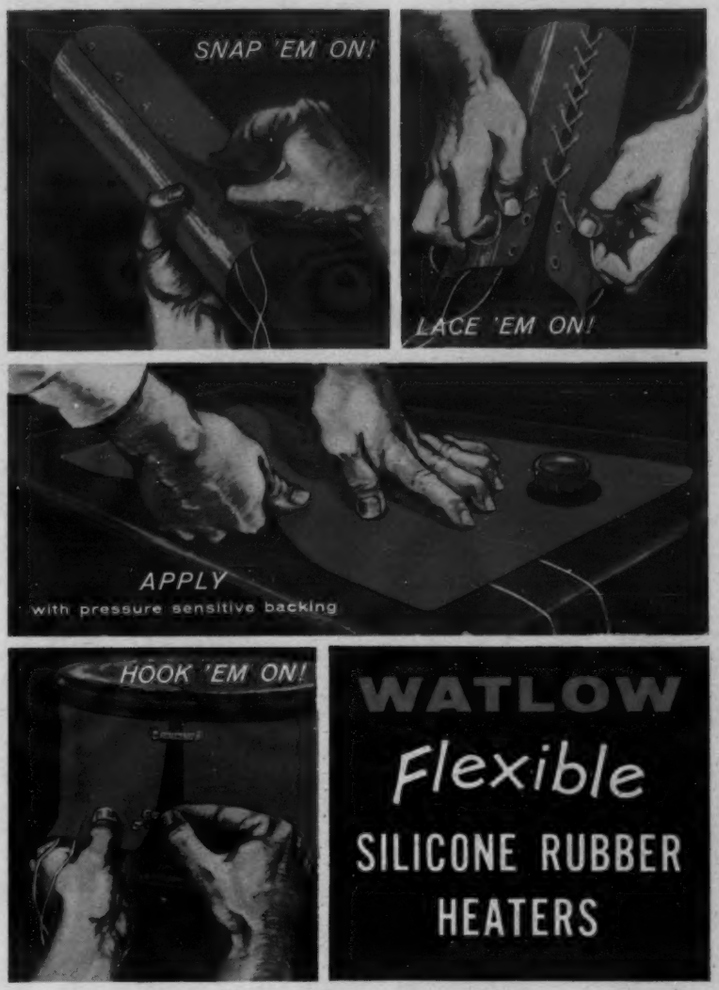
TOOL WEIGHS 4½ lb and is suitable for driving up to ¼-20 studs.

Instead of Sharp Acceleration



CONVENTIONAL DESIGN

BOOSTER AND FASTENER are inserted into tool and base is placed against work surface. Hammer blow accelerates ram piston. Booster is ignited when sufficient resistance is developed by material, to provide slow-burning discharge against piston and fastener. Fastener is seated when piston is flush with tool base and gases are vented through relief ports. Remaining energy in piston is absorbed by work surface and safety washer. Latter prevents hardened tool steel piston from impacting tool steel base plate. With insufficient resistance in material, piston deforms safety washer, making it difficult to retract and indicating washer should be replaced. Premature discharge is prevented by semicircular step on top surface of piston.



Light weight, flexible, only .050" thick. Teflon leads standard, other types on request. Can be rated at any wattage or voltage. Varied heat distribution pattern possible. They are water resistant and easily applied to any plane surface.

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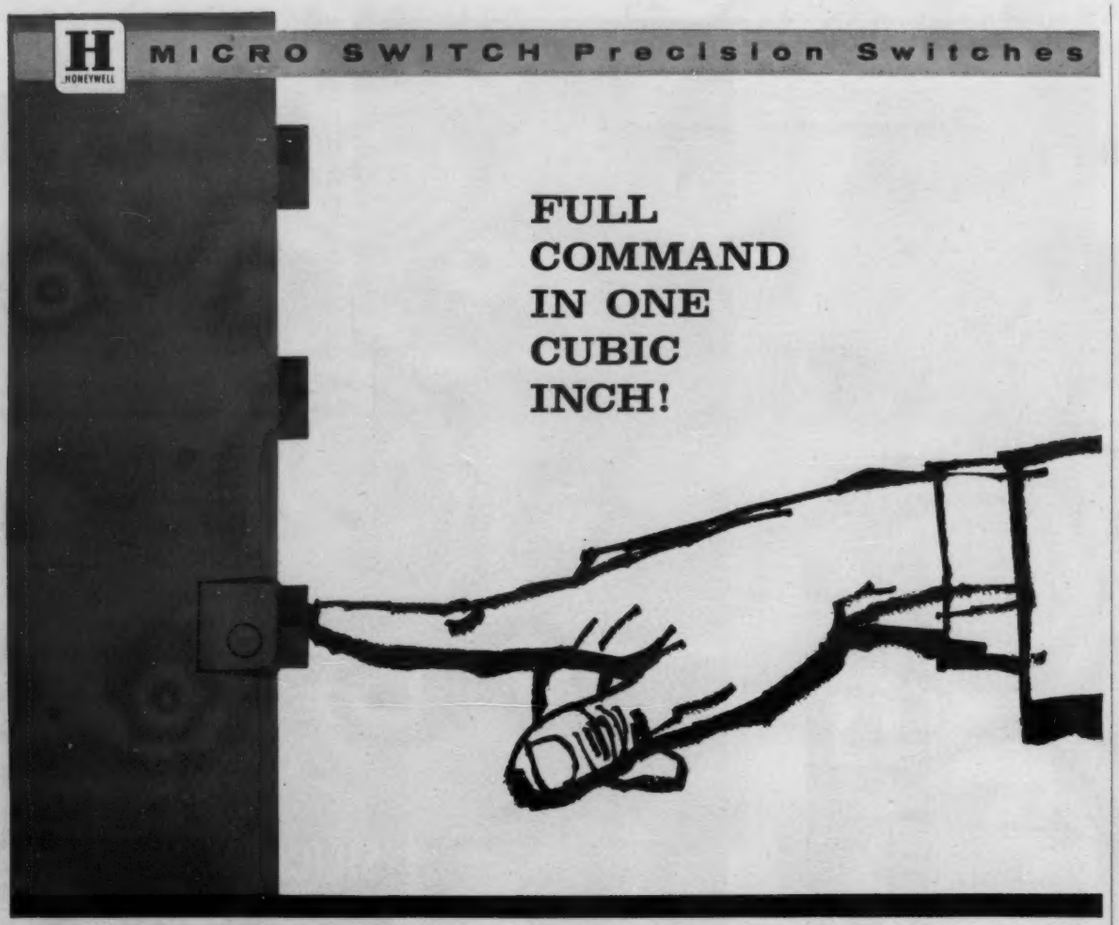

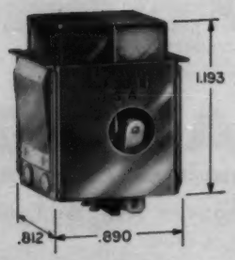

NEW MINIATURIZED LIGHTED PUSH-BUTTON SWITCHES SAVE PANEL SPACE

The new "302PB" Series combines control and visual indication in one completely assembled unit that requires less than one cubic inch of panel space. These miniaturized lighted push-button assemblies can be mounted or removed without tools.

The display screen, mounting flanges and two single-pole double-throw basic switches are all integral components, permanently assembled to make a mechanically strong unit built for long life. Fifteen display screen color combinations are available, obtained by use of a split screen. A separate miniature lamp illuminates each half of the screen. These lamps are designed for infinite service life. "302PB" Series switches conform to the applicable requirements of MIL-S-6743, MIL-S-6744 and MIL-E-5272A. Check the nearby MICRO SWITCH Branch Office, listed in the Yellow Pages for full information or write for Data Sheet 182.

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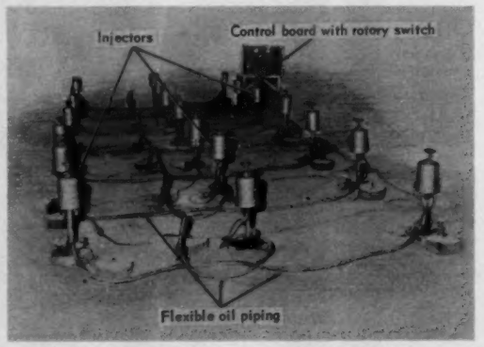
Adjustable Piston Injector

Celestino O. Lubatti, Italian Editor

A solenoid-driven piston for each fuel injector of a continuous brick kiln eliminates complex pressure piping and multiple-piston feed pump. Heavy oil is gravity-fed to the injectors through common pipes. A rotary switch energizes injectors scheduled for firing through plug-in, two-wire lines. Simplification of the firing system reduces installation and servicing costs.

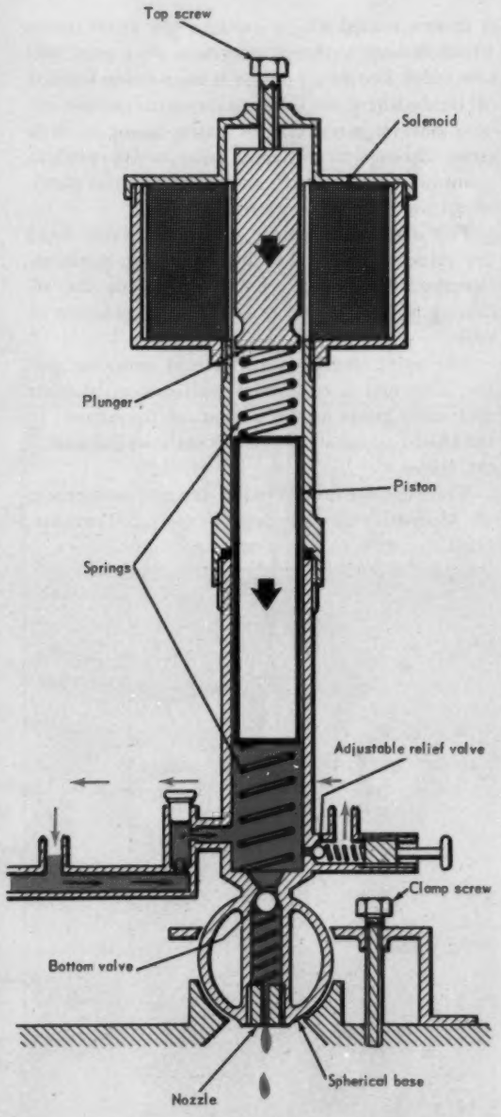
Adjustment screws on the injector unit change the piston stroke, relief valve pressure and nozzle position. These adjustments permit proper variation of fuel quantity, jet reach and direction for maximum kiln efficiency and fuel economy. Straight nozzle hole with large diameter allows use of very heavy, unfiltered oils. Although the fuel is not atomized, but simply ejected into the kiln, quick and complete combustion is developed by the entire volume of preheated air feeding only one fire at a time. The method cuts fuel expense by 40 percent and burning time by 30 percent.

The rotary switch permits variation of work cycle period according to type of bricks processed in the kiln. Fire advances from one chamber to next, in sequence with burned-brick removal and placing of green bricks for burning. The firing equipment is produced by AIEM di V. Rovere, Magnano Rivera, Udine, Italy.

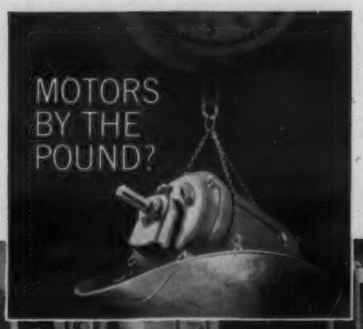


GRAVITY-FED OIL INJECTORS are placed on top of various chambers of Hoffmann kiln. Power required to fire one chamber is less than 0.5 kw.

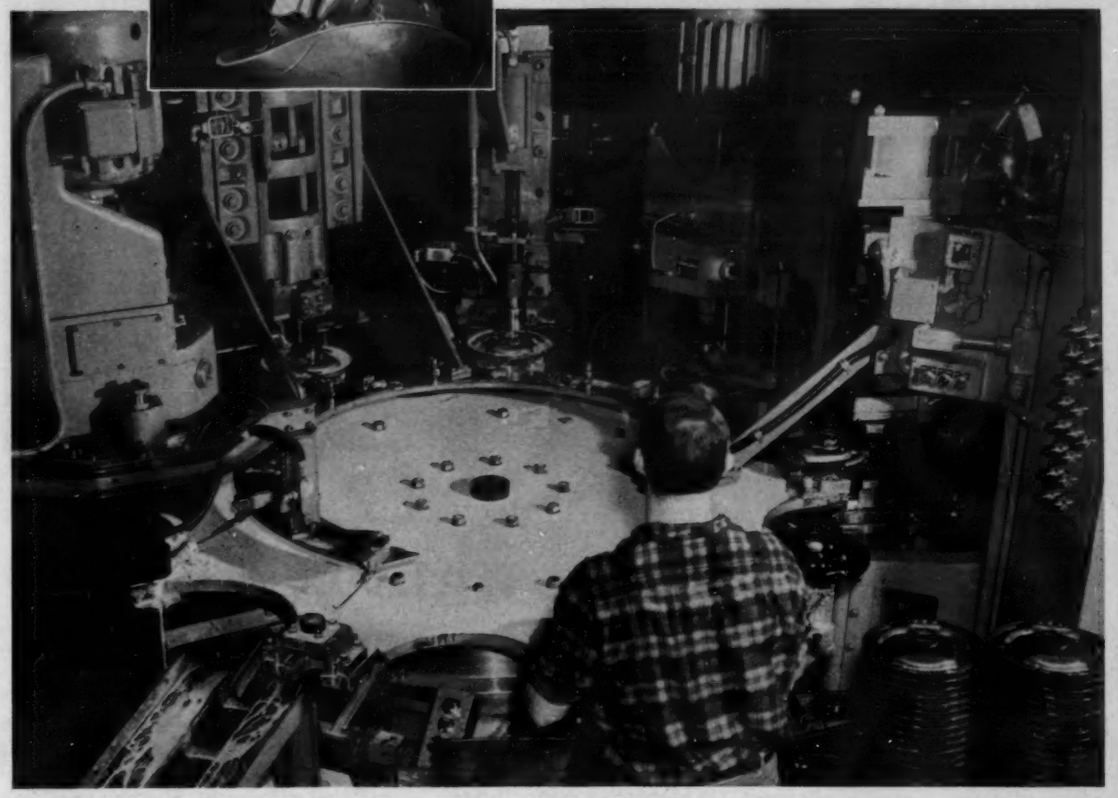
Simplifies Multiple Firing



OPPOSITE COIL SPRINGS, with different elasticity, counteract impact and rebound developed by solenoid plunger, return piston to normal when solenoid is de-energized. Piston pressure ejects oil through nozzle; relief valve limits fluid pressure and jet reach. Top screw varies piston stroke to supply proper volume of fuel chamber. Spherical base of injector can be released by clamp screw for adjustment of jet direction. Fluid for next firing operation is sucked into injector by return of piston.



You're buying motors by the pound when price is the only consideration



Today's machine tools can't afford motors selected on the basis of price alone

Modern machine tools are designed to manufacture products of great precision at the lowest possible cost. But a machine tool is only as productive as the electric motors that drive it. Motors purchased on the basis of price alone often fail to give their users the greatest value in terms of useful service life.

The selection of the right motor to power your products requires not only specification of type, rating and operating characteristics, but consideration of such factors as uniform, troublefree performance, dependable long-life operation, the reputation of the manufacturer, and his ability to provide immediate repair parts and service —when and where they're needed. Wagner® motors have earned their reputation for proven dependability in their specific applications.

Next time you buy motors, check beyond the purchase price. Make sure that you get all the performance you need—with motors that will do the job.

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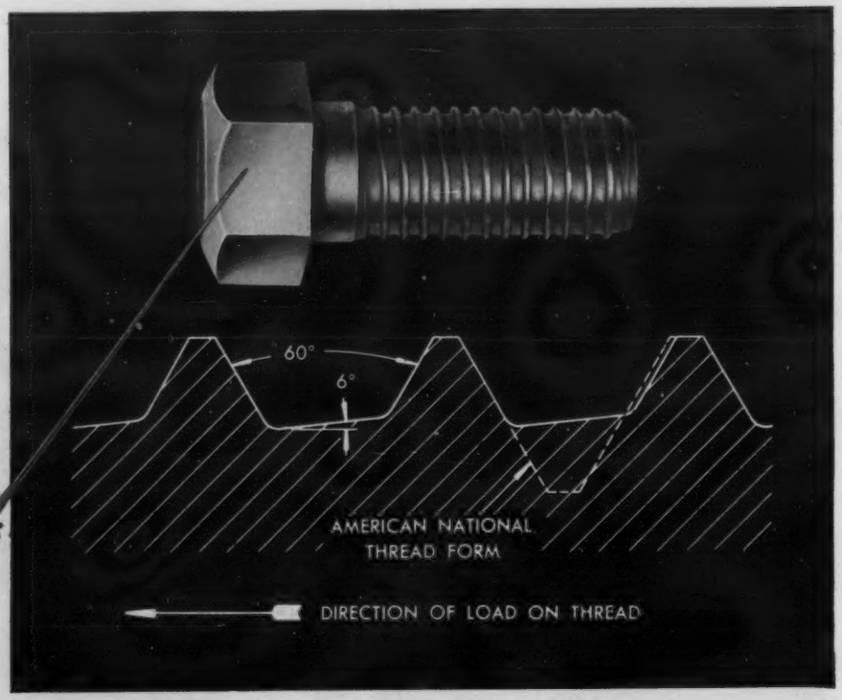
NAT'S quick facts about Fasteners...



Can **any** fastener actually **become tighter** in service?

WELL, HARDLY. NOT JUST *ANY* FASTENER...

But self-locking, extra-strength LOK-THRED® bolts, studs and screws *do*, and even after long service you can expect their breakaway removal torque to average about 70% higher than at installation.

Here's the reason. Just take a look at the LOK-THRED profile. Notice the extra-wide root? And its converging angle? It's held, strictly by design, to exactly 6 degrees.

Now, see what happens, as you drive any LOK-THRED fastener. It re-forms the metal of the receiving thread, squeezing out every void, and forming an intimate metal-to-metal contact. And each of the angled roots becomes a 6-degree tapered wedge, with the loading constantly pulling against it to make its anchorage even firmer.

That's why LOK-THRED fasteners actually *do* become tighter in service. They're self-sealing, too... fluids can't leak past them. And yet they're fully reusable... require no selective fits... can be used with ordinary tools.

Take our word for it, there are plenty of reasons* why LOK-THRED is superior for many kinds of fastening... and we'll be glad to help you develop any applications to your own products.

*They're all given in National's LOK-THRED booklet, with plenty of supporting data. Write for your copy.

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IDEAS...

MECHANICAL DEVICES

Toggle Makes Mud Suction

Edward W. Schrader, Western Editor

A lever-actuated toggle replaces the usual handwheel and screw thread operation on a mud suction valve. Foolproof design is required in foreign oil fields, where the local governments require use of a certain percentage of native labor in drill crews. Strange as it seems, some native workers cannot remember which way to turn a valve handwheel for opening or closing a valve.

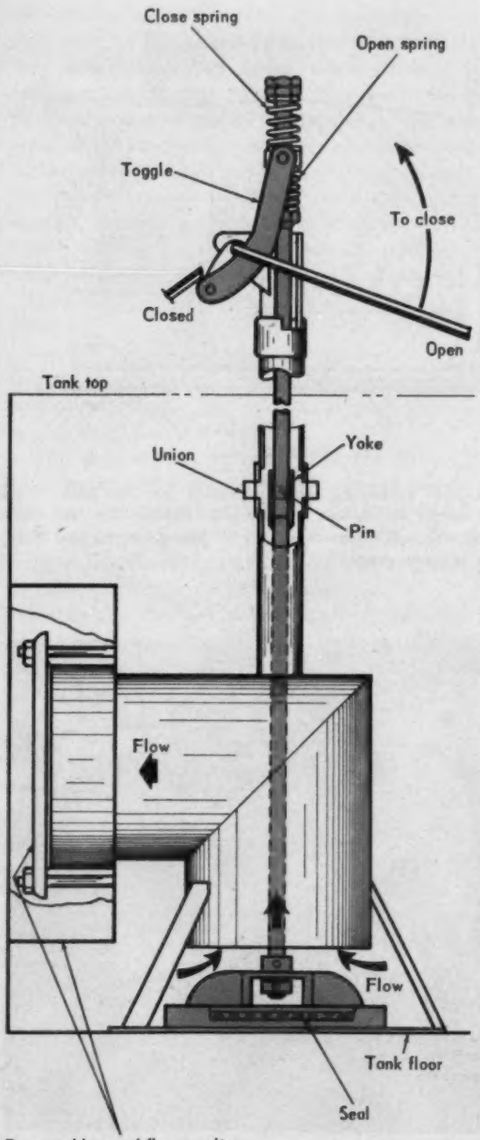
The overcenter, toggle action positively locks the valve in either the closed or open position. Compression springs on the shaft give the retaining force in either open or closed position of valve.

The valve closure is an annular neoprene gasket. The seal is contained within a valve plate and valve guide at the bottom of the elbow. In the closed position, the gasket seals on the end of the elbow.

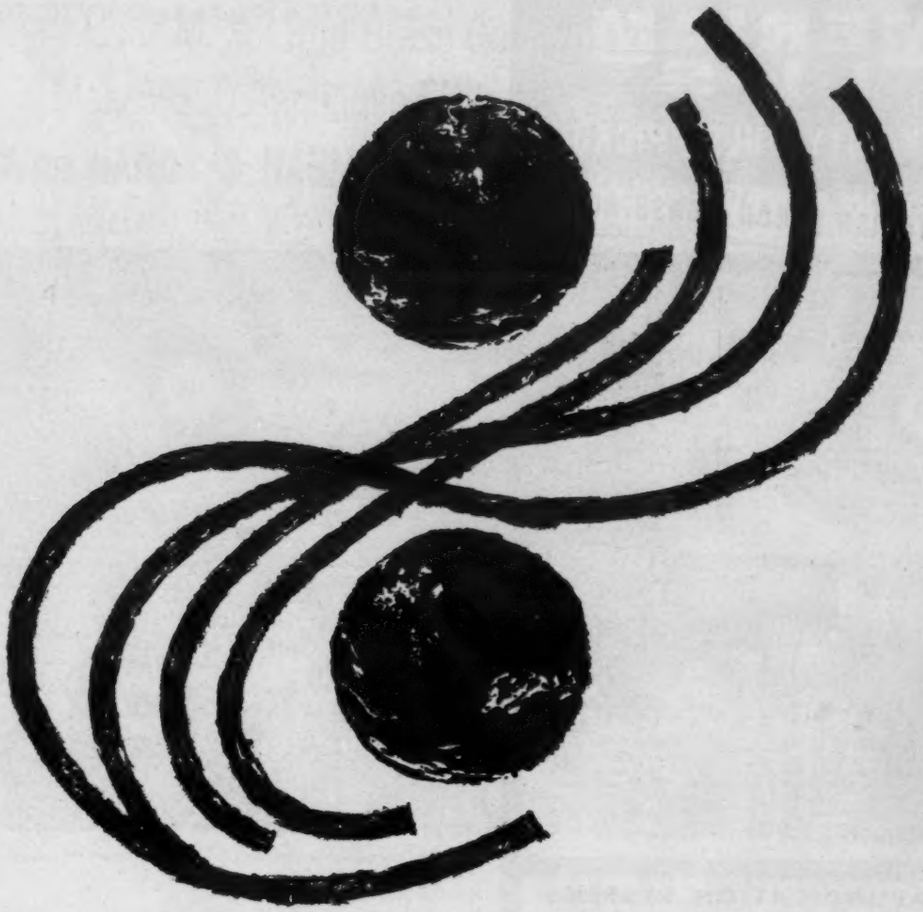
The mud suction valve is a design development of Medearis Oilwell Supply Corp., Torrance, Calif.

MUD SUCTION VALVE uses O-rings packed with grease to seal off valve stem. Valves are made in 6- to 16-inch diameters. When compounding pumps against quick-opening valve, upper spring that holds valve in closed position is replaced with nipple.

Valve Foolproof



QUICK-OPENING VALVE uses color-coded lever, as well as lever position, to indicate open or closed position. When yellow side of lever is up, valve is open; if red side is up, valve is closed. Pipe union on stem provides means of breaking assembly down for smaller volume in trans-ocean shipment. Pin joins upper and lower shaft by means of yoke at pipe union.



Said Johann Kepler: *"The planets move in elliptical orbits about the sun, and the square of their periods of revolution are proportional to the cube of their mean distances from the sun."*

With interplanetary voyages fast becoming a reality, complete information regarding the velocity requirements for travel between planets is of vital importance. With these data available, it is possible to analyze propulsion requirements, plan ultimate system configurations, and conduct feasibility studies for any particular mission.

Lockheed Missiles and Space Division scientists have actually evolved a rapid-calculation method, utilizing a high-speed computer. This has produced literally thousands of orbits, velocity requirements, and elapsed time, for design studies of trips to and from both Mars and Venus—every tenth day from now until January, 1970.

More simple to analyze are many factors which make Lockheed Missiles and Space Division a wonderful place to live and work. Located in Sunnyvale and Palo Alto, California, on the beautiful San Francisco Peninsula, Lockheed is Systems Manager for such programs as the DISCOVERER and MIDAS satellites and the POLARIS FBM. These, together with research and development projects in all disciplines, make possible a wide diversity of positions for creative engineers and scientists in their chosen fields.

Why not investigate future possibilities at Lockheed? Write Research and Development Staff, Dept. M-14 C, 962 West El Camino Real, Sunnyvale, Calif. U.S. citizenship or existing Department of Defense industrial security clearance required.

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for precise speed measurement
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Model 2050
Magnetic pickup built for heavy-duty service in industrial, military and experimental applications where space is limited and reliability essential.

Model 2043
Magnetic pickup designed to sandwich between a tachometer generator and an AND 20005 engine mounting pad. Rear flange accommodates standard 3-phase electric tachometer generator.

Model 1312
Electronic
Tachometer

Model 2040
Compact lightweight magnetic pickup designed for mounting to an AND 20005 engine pad . . . also for checking other rotating devices which require high resolution per revolution.

Model 2095
Photo-electric pickup is ideal for low speed applications . . . process control . . . measurement of linear dimensions and angular movement.

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Model 2020
Dual-signal generating device provides electrical impulses to operate electronic counters plus a 3-phase signal to operate 3-phase synchronous electric tachometer indicators.

Model 2030
Tachometer generator assembly for heavy-duty use in both military and industrial locations. Provides a 3-phase signal to an electric tachometer indicator.

Model 635 Speed Indicator

Performance-proven in heavy-duty military and industrial service, MERIAM magnetic and photo-electric pickups and tachometer generator assemblies withstand severe moisture, temperature and vibration conditions. All models available in explosion-proof housings for operation in hazardous areas . . . indicators can be installed as far as 500 feet from pickups.

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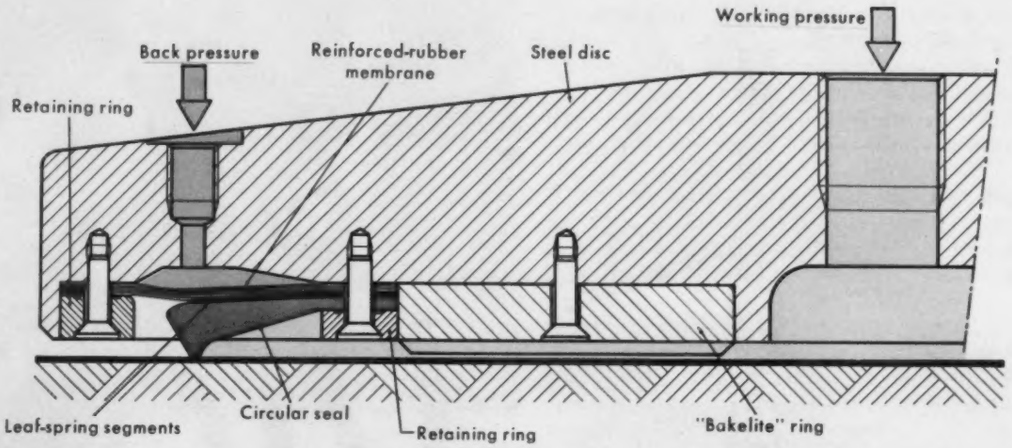
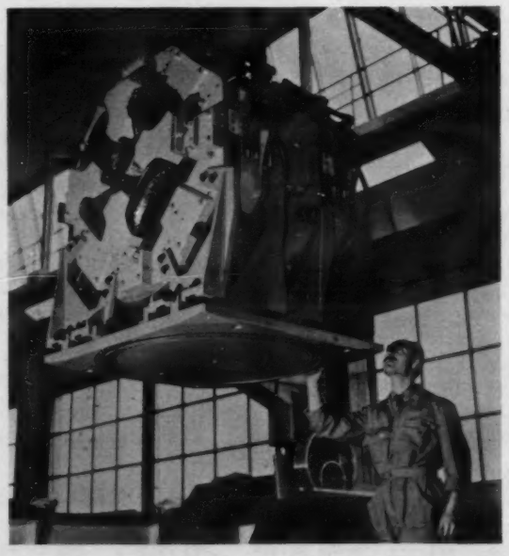
IDEAS . . .
MECHANICAL DEVICES

Air-Pad Uses Back Pressure

Dr. A. A. Niesper, Correspondent in Switzerland



CROSS-SECTION shows how working pressure is admitted through center of steel disc. It is governed by load to be carried and pad size and must not exceed approximately 60 psi. Back-pressure behind seal assures positive contact of seal on floor. Leaf-spring segments stiffen seal but allow it to fit snugly on surface irregularities. Replaceable "Bakelite" ring with radial grooves for free air passage carries load when air pressure drops.



SYMMETRIC LOAD permits use of single air-pad, here of 38-inch dia to carry 5 tons.

STEEL SHEETS on rough floor with joints sealed off with tape facilitate easy movement of 20-ton bending magnet on four 20-inch air-pads. Good results are obtained on bare concrete floor with all cracks covered.

for Effective Sealing

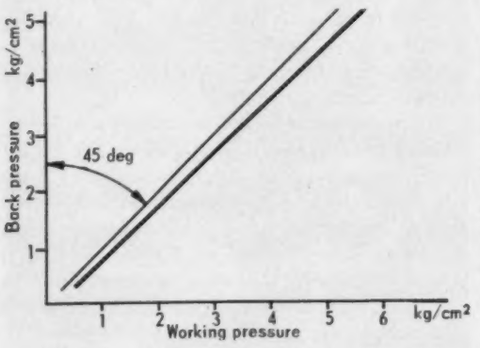
Static air pressure retained by a circular seal is used to lift heavy equipment approximately 1/16 inch above floor so it can be moved accurately and with little effort. Main lifting pressure is fed through the center. A slightly lower back-pressure fed near the periphery holds the seal against the floor. The friction coefficient for shifting a load of 30 tons, mounted on four pads, on a smooth concrete floor was found to be 1 percent or 30 times lower than an equivalent steel plate. CERN (European Organization for Nuclear Research) finds this transport system especially useful for the alignment of physical apparatus to fixed flight paths of particle beams.

One or more pads may be used according to size and weight of the load to be moved. With asymmetric loads, each pad must have its own pressure-regulating system.

The pressurized air pad is totally different from systems like the Curtiss-Wright air-suspension car which take advantage of the dynamic flow of large quantities of air to lift smaller weights higher above ground and to move them at high speed over rough surfaces.

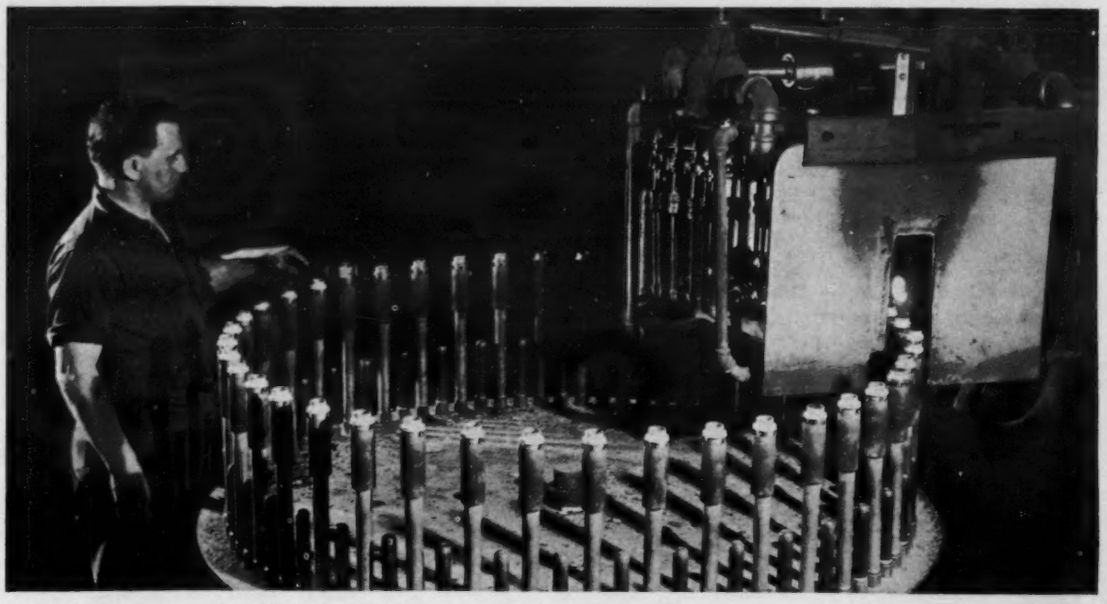
Advantages claimed include small air consumption, lower cost than any other transport system like carriages, reduced space requirements particularly in height, free and accurate movement in all directions, and simultaneous use as permanent support.

The pressurized air-pad is designed by Mr. Augsburger, Proton Synchrotron Div., CERN, Geneva, Switzerland.



BACK-PRESSURE is linear with working pressure and only approximately 5 psi smaller. On smooth floors both pressures could be equal, simplifying control. Slightly reduced back-pressure, however, lets some air escape, lubricates seal, reduces wear.

Every Hour M. S. Little Brass Goods Company Makes 650 Appliance Fittings Better With HANDY & HARMAN SILVER BRAZING



Rotating jig showing mounted assemblies entering and leaving gas-air furnace.

Left– brazed assembly. Right– components with preform ring of EASY-FLO *45.*

This Hartford, Connecticut, company makes—in volume—an assembly that goes into the overflow system of household appliances. The assembly consists of brass tubing and a machined brass casting. The two components are joined by a preplaced ring of Handy & Harman EASY-FLO 45 silver brazing alloy and HANDY FLUX. Heating is automatic gas-air; parts are placed on a rotating turntable to pass through the gas furnace. Every 60 working minutes, 650 assemblies are completed.

The advantages here are that the manufacturer can use thin-walled tubing with heavier, threaded components at no sacrifice in strength. Because of EASY-FLO's penetrating qualities, the entire shear area is fully as strong as the solid parts of the assembly, yet considerably lighter. And, casting and machining the components for this assembly have been greatly simplified.

Are you in pursuit of a metal-joining method which offers—among other advantages—high, uninterrupted production at low capital investment? You may easily find the answer in Handy & Harman silver brazing. Hundreds of manufacturers and fabricators of as many different products, parts and components are right now enjoying the speed, economy, strength and *flawlessness* of brazing. You can too. Just ask Handy & Harman, 82 Fulton Street, New York 38, N. Y.

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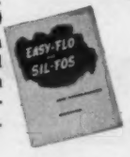

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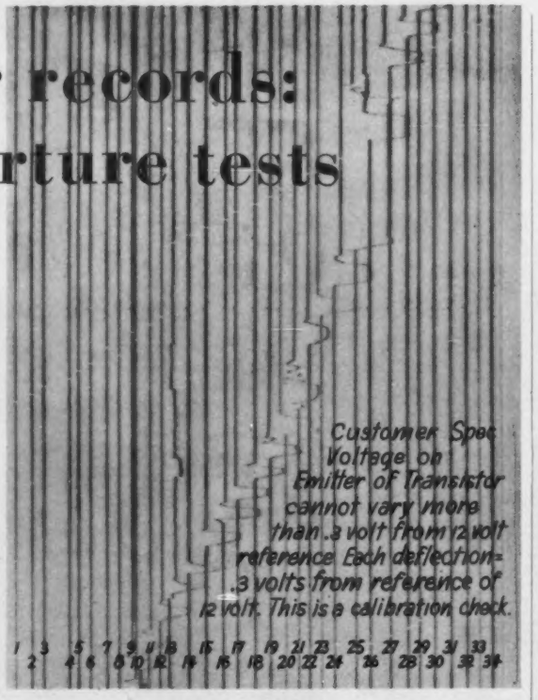
The Visicorder records: transistor torture tests

Transistors often have to work under incredibly severe environmental conditions. Production-testing them gave engineers at Honeywell's Semiconductor Division a chance to exploit the great versatility of the 36-channel Visicorder oscillograph Model 1012.

A certain order of transistors had to withstand vibrations of 10G at 10 to 2,000 cps without failing during the test or as a result of it. A standard test had been to measure the transistor's performance, next subject it to non-active vibration (not in any circuit), and then re-measure. This approach was obviously deficient as it did not reveal *operating* characteristics during test, nor did it disclose *intermittent*-type failures.

The customer's quality requirements were stringent (AQL = .4%) and the large test sample



Unretouched record of vibration test on 36 transistors, each active in its own circuit during test.

In this photo, shaker table is at right and amplifier-circuit rack at left, flanking the 36-channel Model 1012 Visicorder.

required ruled out the use of an oscilloscope. The 3-hour test would have made a battery of scopes and operators necessary; transient defects would be missed due to eyestrain, fatigue, etc.

The Model 1012 Visicorder was chosen for the task as it simultaneously measures and records 36 channels of test information throughout the test period. The Visicorder instantly and directly records transients, no matter how random.

A Visicorder record like this is always a welcome supplement to your test data—your customer will be able to read it quickly and with full understanding. And it is a *permanent* record which *he* can show to *his* customer, if necessary.

For further information on how Visicorders can help to solve your instrumentation problems, contact your nearest Honeywell sales office without delay. Or write for Catalogs HC 906, 1012, 1108 and 1406, to:

Minneapolis-Honeywell, Heiland Division, 5200 East Evans, Denver 22, Colorado, SK 6-3681—Area Code:303

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Honeywell

Industrial Products Group

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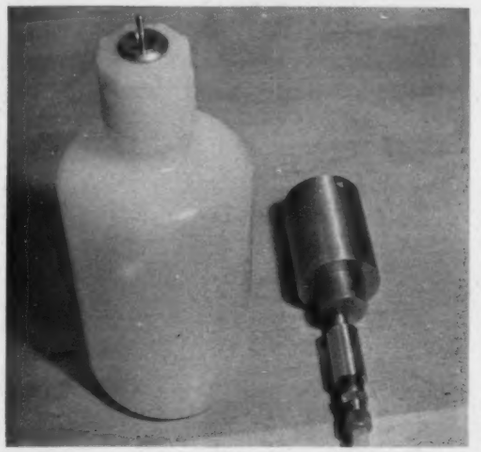
IDEAS . . .

MECHANICAL DEVICES

Constant Liquid-Level Device

Lars G. Soderholm, Midwest Editor



A constant liquid-level device uses an inverted fluid container having an orifice located within a holder at a level at which the fluid is to be controlled. A drop in level admits air into the container which permits liquid to flow out until the orifice is again covered.

Proving that "necessity is the mother of invention", a machinery builder used what he calls the "watering-trough" principle to build a constant liquid-level device when he could not buy one. The need was for a device to hold an acid flux level in a soldering machine.

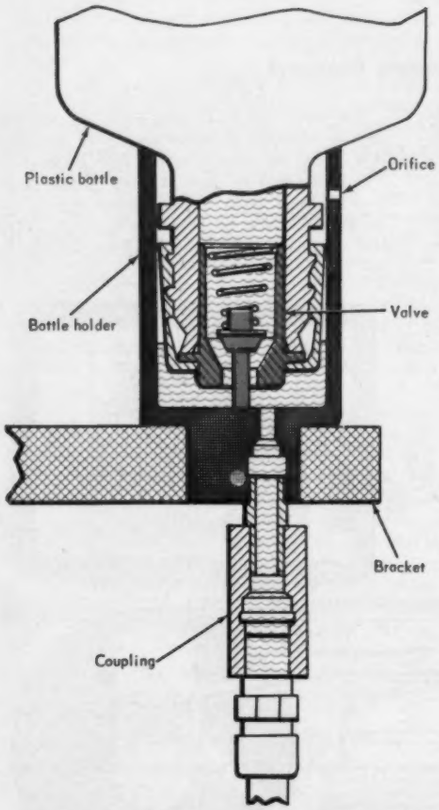
A standard polyethylene bottle is used as the container with a hole drilled in the bottle cap. A valve body is set into the cap with a spring-loaded valve. The little refinement eliminates spillage when installing in the holder and makes for safer handling.

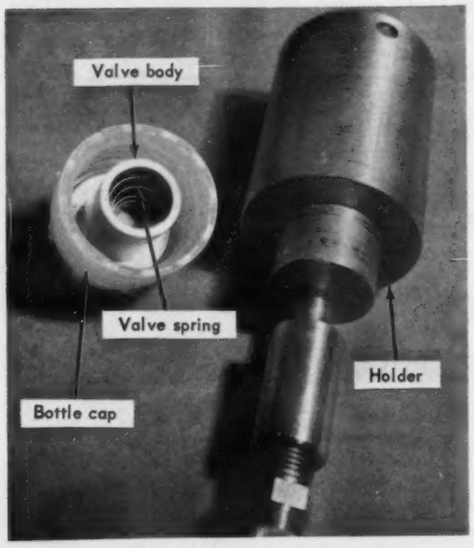
When the bottle and valve assembly is inverted and set into the holder, the weight of the bottle and of its contents forces the valve open and allows the fluid to run into the holder and through plastic tubing to a container in which the liquid level is to be established. The level is held at the same elevation as the opening in the valve body of the container. The holder is clamped to maintain the position required.

Use of a polyethylene bottle permits liquid level to be checked visually. All metal parts are machined from type 304 stainless steel.

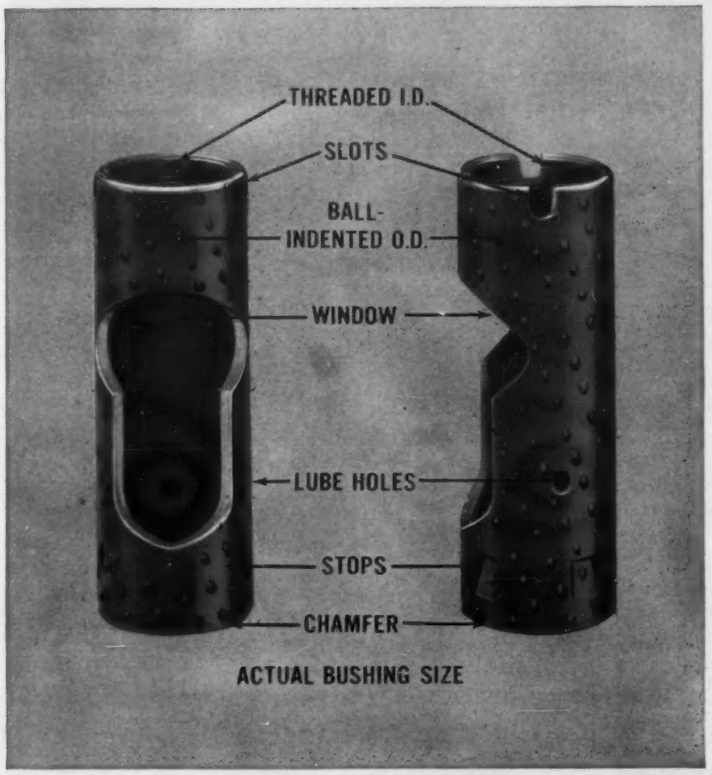
The constant liquid level device is made and sold by the Hopkins Machine Corp., Chicago, Ill.

Uses Air Orifice

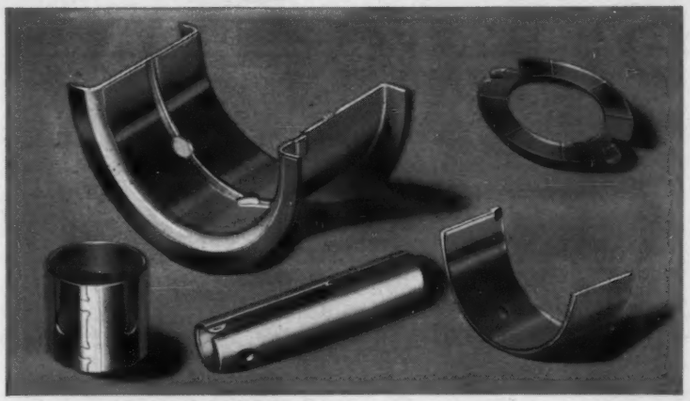




"EXOTIC" BUSHING MAKES NEW STEERING DESIGN COME TRUE



INSIDE-OUT BUSHING HELPS PUT NEW STEERING MECHANISM INTO PRODUCTION! To perfect a new steering mechanism, an automotive manufacturer required a linkage component. Designers tried making it of machined steel, then plastic . . . both materials failed. But the unusual bushing shown at left, with a number of features F-M engineers helped designers incorporate, solved the problem. It is bronze-on-steel, formed with the ball-indented bronze on the O.D. so the bushing can accommodate sliding motion within the mechanism. A large window makes insertion of a ball socket easy during assembly. Design of the bushing also includes: stops near one end to hold a disc . . . a threaded I.D. on the other with slots for a locking pin . . . holes that supply lubricant to the outer surface. For the F-M customer, all these built-in features helped accomplish this result—easy, efficient assembly and success with a new design.



CAN F-M BUSHINGS SOLVE problems on your board or on your assembly line? Or perhaps a sleeve bearing, thrust washer or spacer? F-M, who makes them all, can provide the answer. F-M engineers, with a wealth of knowledge from years of experience, are available to help design the needed component. This complete technical assistance is one reason why these F-M products are widely specified for use in automobiles, farm equipment, construction machinery and many other products.

Additional information about bushings is provided in a Design Guide, published by F-M. Helpful literature is also available on sleeve bearings, thrust washers and spacer tubes. For your copies, write Federal-Mogul Division, Federal-Mogul-Bower Bearings, Inc., 11055 Shoemaker, Detroit 13, Michigan.

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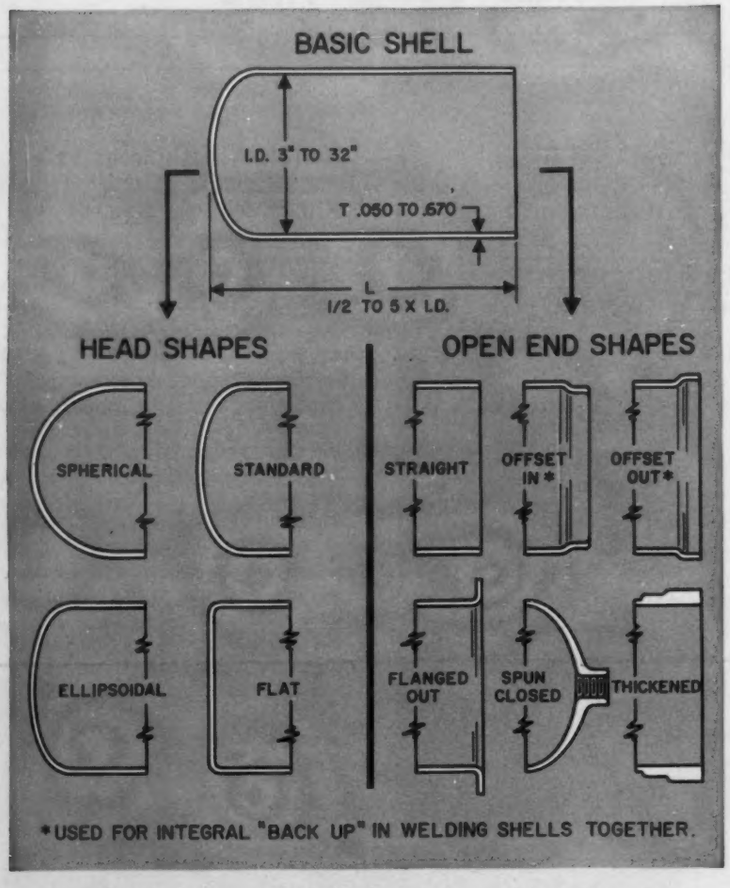
Your ideas...our methods...give you reliable components at low cost



The drawings shown here give you a simple description of the way you can use basic Hackney shells to produce a variety of seamless, lightweight, strong, low-cost rocket motor cases, gas generator housings, control actuator pressure vessels and other missile components.

The basic unit is a cold drawn, deep shell which has uniform wall thickness from top to bottom in ranges from .050" to .670". I.D.'s vary from 3" to 32". The length of the shell may be from ½ to 5 times the diameter—or up to 110".

Head shapes—spherical, standard, ellipsoidal, flat or special. *Open end shapes* offer variety—straight cut, offset in, offset out, flanged out, flanged in, spun closed or thickened. *Capacities* begin at 1 quart—go as large as 100 gallons. *Working pressures* range from 100 to 6000 psi, depending upon diameter and wall thickness.

For full details of our facilities and our methods of making components, write to the address below.

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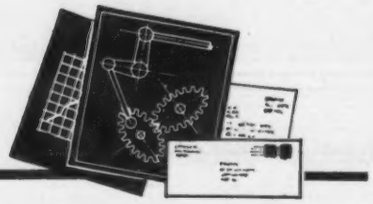
IDEA MART

DESIGN NEWS



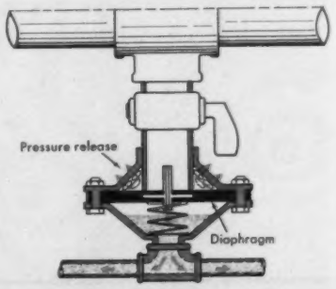
AVAILABLE

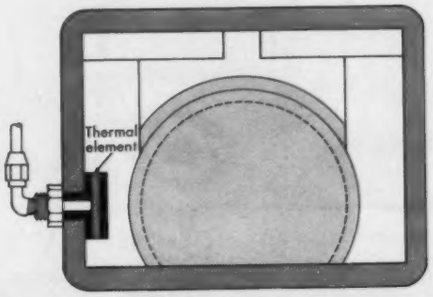
The Thermatic Blogard

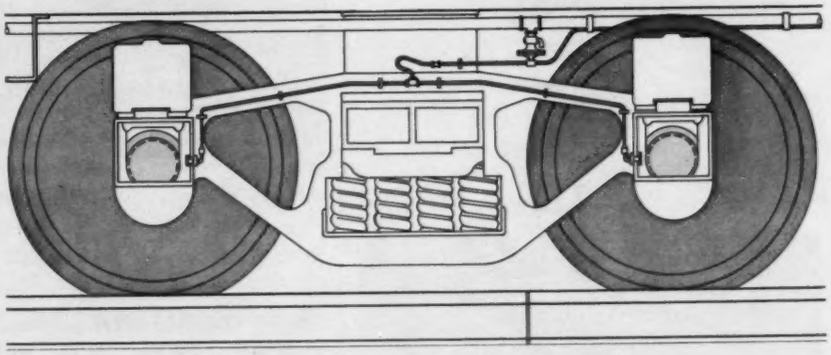
Between 60 and 65 percent of all railroad wrecks are a result of journal failure, or "hot box".

In the device shown, when a journal overheats, it melts a thermal element, opening a small air vent which actuates the relay valve, opening a larger vent on the main air line, reducing the pressure and applying the brakes.

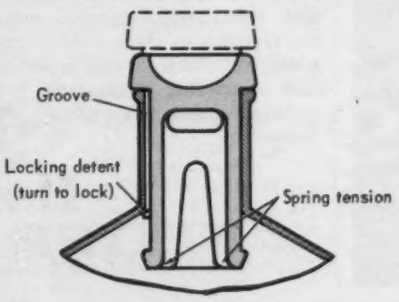
The device has no friction parts and will not require attention or maintenance after installation. It can be adapted to any type of journal. The inventors have been notified of patent allowance with seven claims. Patent rights are available for sale or lease. Write A.B.C., Idea Mart, DESIGN NEWS, 20 N. Wacker Dr., Chicago 6, Ill.







Collapsing Tube Cap



The closure cap is pressed into the mouth of the tube when assembled and cannot be removed as the spring-like tension of the two hook prongs will not close in for removal.

In use, the cap is turned slightly. Pressure on the tube will open it automatically or, if desired, it may be pulled out by hand for dispensing. Although a threaded cap is mentioned, the detent and groove idea is best.

A manufacturer is desired for this item although this is the first effort to be made to seek a manufacturer. Write J.O.M., Idea Mart, DESIGN NEWS, 20 N. Wacker Dr., Chicago 6, Ill.

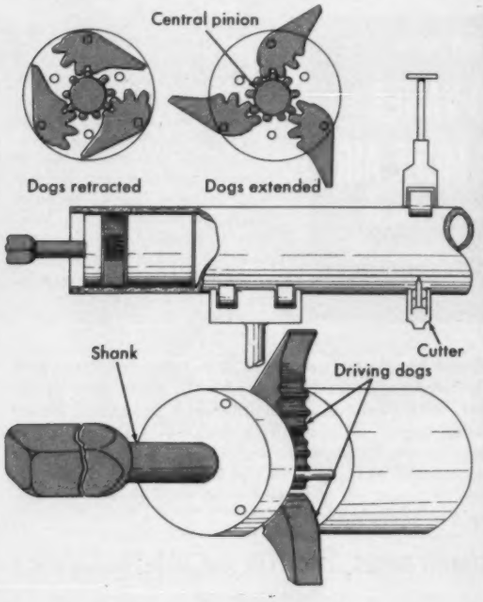
AVAILABLE

Internal Pipe Chuck

This chuck is used with a portable power vise for turning pipe smaller than two inches in diameter. The cutting and threading may be done in the machine. When larger stock is to be cut and threaded, the stock is clamped by other means and the cutting is done by manually operating the cut-off tool. Threading then is done by the use of back geared dies driven by the machine. A drive shaft is coupled to the die and the other end is locked in the jaws of the machine.

The tool is used by inserting it in the end of the stock to be cut off. Its square shank fits into the drive shaft and the drive shaft is chucked in the power vise. The pipe may be placed upon rollers, or it may be left on blocking on the ground with any suitable device provided to hold it from rolling off. When the power is turned on, the pinion gear in the tool will force the driving dogs outward against the inner wall of the pipe and cause it to be rolled. The operator may then apply the cutter to as many cuts as he desires, beginning at the end away from the chucked end. His job is lessened to nothing more than applying the cutter and tightening it until the cut is made. The work is absorbed by the power vise. When the cuts are made and the power is turned off, the tool is released and may be slipped out.

This tool is extremely simple and effective. It comprises three geared, freely moving driving dogs. These are actuated by the central pinion which is one piece with the shank. These dogs are held in place by tough pins through their centers of movement. Spacer pins permit them freedom in the mounting. For each size pipe to be cut, an adapter is furnished which merely holds the tool centrally until the drivers take hold. Each additional adapter fits over the last and is held by set screws. Any number or all of the adapters may be removed by loosening a set screw in the proper place. Two sizes of this tool are made. One size fits 2½- to 4-inch stock. The other fits 4- to 6-inch stock. Write C-46, Idea Mart, DESIGN NEWS, 20 N. Wacker Dr., Chicago 6, Ill.



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IDEA MART...

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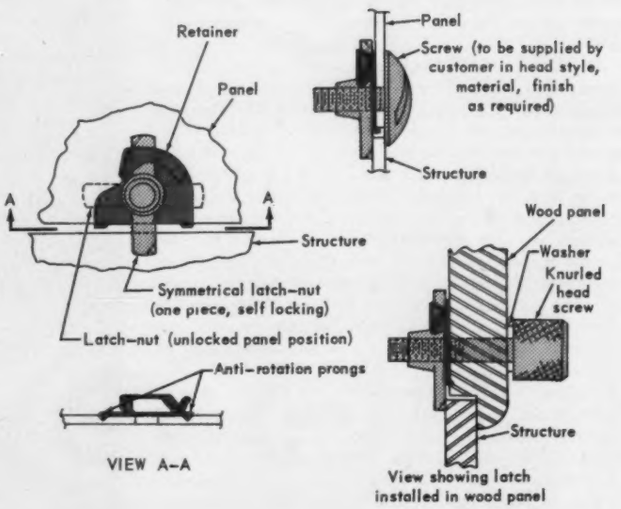
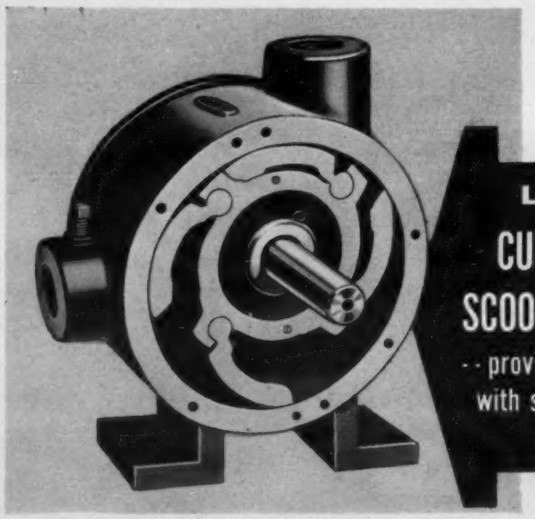
Quarter-Turn Panel Latch

This quarter-turn panel latch is self-adjusting for panel thickness and is self-locking. It consists of a screw which is supplied by the customer in head style, material and finish as required, and a retainer with an integral locking finger and symmetrical self-locking latch nut. The screw is inserted into a hole in the panel and the hole in the retainer, then turned into the threads of the latch nut until the desired adjustment is obtained. The prongs on the retainer prevent rotation by overhanging the metal panel edge or by anchoring the retainer in a wood panel.

After initial adjustment, the latch will lock or unlock in a quarter turn, the screw and the latch nut turning as a one-piece unit because of the high friction in the latch nut self-locking threads.

This latch may be used in removable panels, hinged doors or sliding drawers. I wish to sell or license this invention. Write H.E.K., Idea Mart, DESIGN NEWS, 20 N. Wacker Dr., Chicago 6, Ill.





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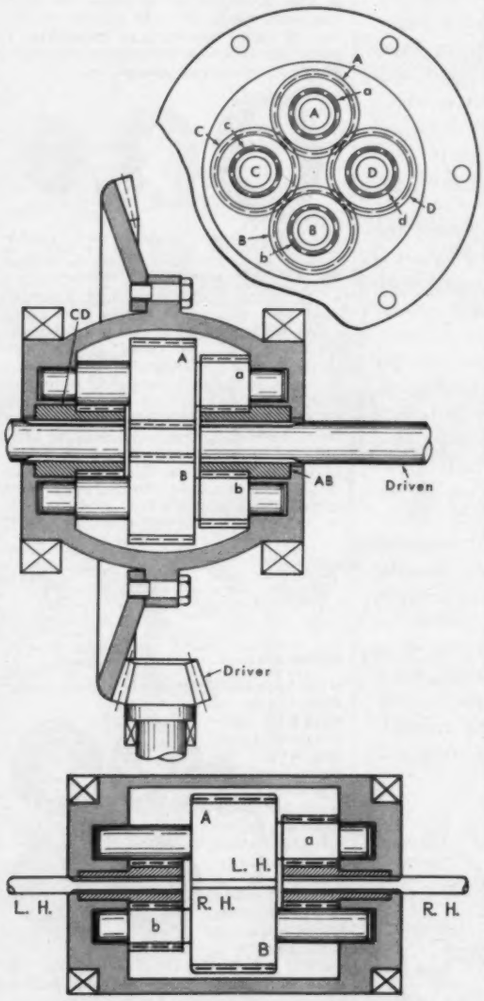
AVAILABLE

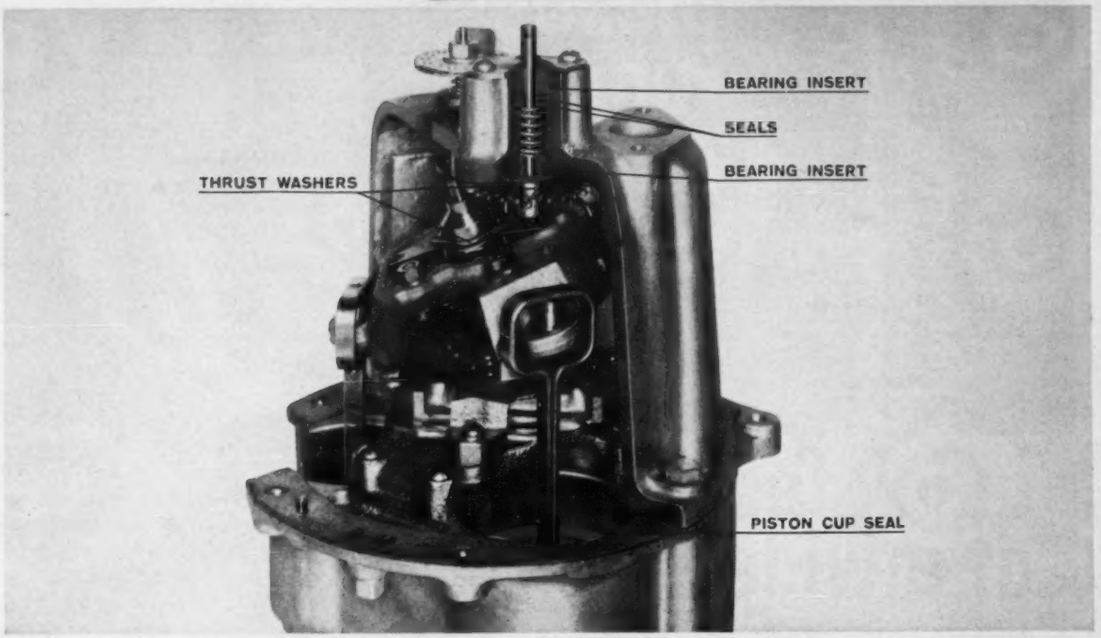
Spur Gear Differential

As shown, there are four spindles that are identical so that spur gears A, B, C and D intermesh. Spindles A and B are placed so that spur gears a and b are to the right. Thus, c and d are to the left. Each driven shaft is splined to enter spur gear AB (at right) and CD (at left). These two driven shafts are removed easily, as is conventional with such differentials. AB meshes with a and b and CD meshes with c and d. Opposite spindles A and B, or C and D, rotate in the same direction. For extra-heavy duty, six spindles are used. Write W. E. G., Idea Mart, DESIGN NEWS, 20 N. Wacker Dr., Chicago 6, Ill.



SIMILAR DESIGN uses only two spindles, A and B. Shaft No. 1 enters spur gear meshed with a on spindle A, and shaft No. 2 enters spur gear meshed with b on spindle B. This would be applicable for lightweight, light load differential as might be required in model or instrument assemblies.

DU PONT TEFLON®



Non-lubricated seals and bearings made with TEFLON® give maintenance-free service in gasoline-pump meter

CAN YOU AFFORD NOT TO USE TEFLON®?

Seals and bearings of TEFLON resins are your logical and most economical choice whenever problems of corrosion or lubrication are encountered, AND whenever you want—

. . . functional reliability and greatly increased service life

. . . reduced costs of replacement, maintenance and downtime

. . . greater standardization with reduced inventories

. . . the competitive advantage of quality and dependability

If any of these considerations are important to your design, the choice of any other seal or bearing materials might well be wasteful.

This new pump meter is built for maximum reliability—designed to withstand the effects of additives in gasolines. The drive rod seals, piston cup seals, sleeve bearings and thrust washers are made with filled compositions of Du Pont TEFLON fluorocarbon resins. TEFLON resins were specified in these vital parts because they have the lowest coefficient of friction of any solid material and are not affected by gasoline.

The zero-leak seals made with TEFLON require no lubrication. They will not age or harden...do not require any maintenance. The bearings offer similar maintenance-free performance.

The simplicity and dependability of seals and bearings made of TEFLON resins open a wide variety of opportunities for improved design. It will pay you to investigate the functional improvements and cost savings made possible with TEFLON. For more information, write to: E. I. du Pont de Nemours & Co. (Inc.), Dept. DN-313 Room 2526T, Nemours Bldg., Wilmington 98, Del.

In Canada: Du Pont of Canada Limited, P.O. Box 660, Montreal, Quebec.

DU PONT REG. U. S. PAT. OFF.

TEFLON® FLUOROCARBON RESINS

TEFLON is Du Pont's registered trademark for its family of fluorocarbon resins, including TFE (tetrafluoroethylene) resins and FEP (fluorinated ethylene propylene) resins.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

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canvas
cardboard
plastics
rubber
aluminum
cloth
plywood
leather

quick fastening of a wide range of materials

Designers, who have let their imagination soar, have discovered that a 50-year old belt fastening method is an exciting new method of fastening many other materials. This Clipper fastener achieves a uniqueness of design. It provides smooth, durable fasteners as flexible as the material . . . fasteners that ride over rolls and pulleys easily without pounding, when required.

For a new approach to hinging and fastening materials such as canvas, cardboard, plastics, rubber, aluminum, cloth, plywood, leather . . . try Clipper. Hooks are available in attractive Bronze, rust-proof Monel and Stainless Steel.

Why fret and fume over that fastening problem? Why not try Clipper and open up new areas of design flexibility. Let us help you experiment . . . send samples of the material you wish to join and we'll demonstrate how it can be done with Clipper fasteners.

ASK TOO, FOR A COPY OF BULLETIN 259: "A GUIDE TO FASTENING SAVINGS".

Ask your Industrial Distributor for Clipper Products

Clipper BELT LACER COMPANY

974 Front Ave. N. W., Grand Rapids, Michigan

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PATENTS

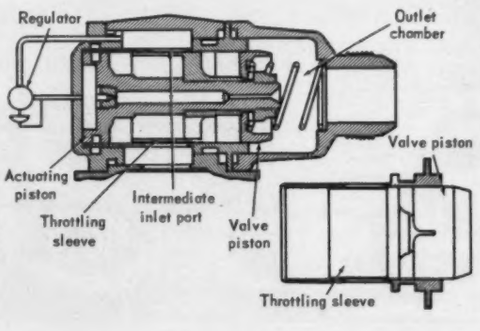
Pressure Regulator

U. S. Patent 2,963,039; William J. Dietz, Jr., assignor to The Bendix Corp., Detroit, Mich.

This regulator is designed to reduce in two stages the pressure of a gas from a fixed volume source.

The body is provided with an annular supply chamber about the intermediate portion of the central cylindrical bore, which has intermediate ports and opens into an outlet chamber. A gas-operated piston assembly consists of an actuating piston, a throttling sleeve and a valve piston which has inwardly flared slots. A spring urges the piston assembly against the end closure wall of the regulator. The piston assembly is urged in the opposite direction by pressurized gas admitted to the space behind the actuating piston.

The actuating gas is provided by conduits connecting the annular supply chamber to a separate pressure regulator and to the space behind the actuating piston. Gas is prevented from passing by a peripheral seal. An axial bleed passage with restricted duct of small diameter connects a recess in the actuating piston with the outlet chamber. The central bore is formed in a tubular member which has the intermediately located inlet ports. At the location of the inlet ports, the throttling sleeve extends longitudinally from the outer ring part of a three-legged spider guide, which directs air rearwardly since the annular ring contacts the wall of the central bore. Air is reduced in pressure by the cross-sectional annular area which results. The valve piston extends partially into the outlet chamber and has an outwardly facing cavity which serves to retain the spring. The piston has a continuous peripheral surface which extends to both sides of the transverse edge of the tubular member so that air cannot flow from the bore into the outlet chamber until the piston assembly is moved to the right, when the four slots will establish a flow path.



PUMP DESIGN TRENDS

ARTHUR A. NICHOLS

PUMP RELIABILITY GREATLY INCREASED BY NEW INTEGRAL DESIGN CONCEPT

► Building ultra-reliability into pumps by building the pumping elements themselves integrally into the casting or frame of the mechanism they serve is a recently developed concept now rapidly being adopted by designers.

► **The development of three low cost elements ready to build into the housing of any mechanism requiring a pumping function eliminates the purchase of complete pumps.**

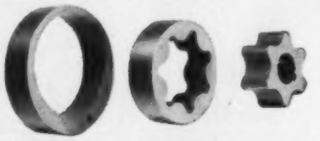


Fig. 1. Three Gerotor components permit pump to be incorporated as integral part of housing or frame of mechanism, eliminate need for purchase and mounting of separate, complete pump.

► Mounting pads, couplings, connectors and accessory drives are done away with by this progress in design. Consisting of an inner and outer Gerotor and an eccentric locator-ring, the unit becomes a complete pump by simply through-boring the casting or frame of the mechanism to accommodate the locator ring O.D. and to provide porting. This design makes the main casting do double duty as the pump housing, thus eliminating a very considerable cost factor. A drive can be taken from any convenient shaft.

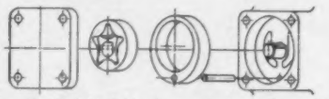


Fig. 2. Nichols integral pump-package is easily installed integrally into most mechanisms.

► **The matched elements are as easily built-in as a simple anti-friction bearing would be. Further, the Gerotor pump is extremely flexible in its configuration and readily adapts to a wide variety of mechanism geometries. It will handle a variety of fluids at rates up to 100 gpm and pressures up to 1,000 psi.**

► *Inquire of:*

W. H. NICHOLS CO.

Makers of Zenith Metering Pumps and the Nichols Milling Machine "the miller that uses its head".

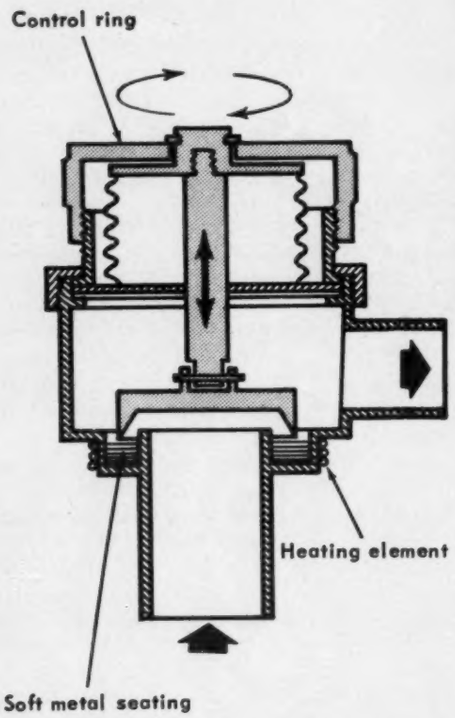
48 WOERD AVE., WALTHAM 54, MASS.

Circle 40 on Reader-Service Card

Vacuum Valve

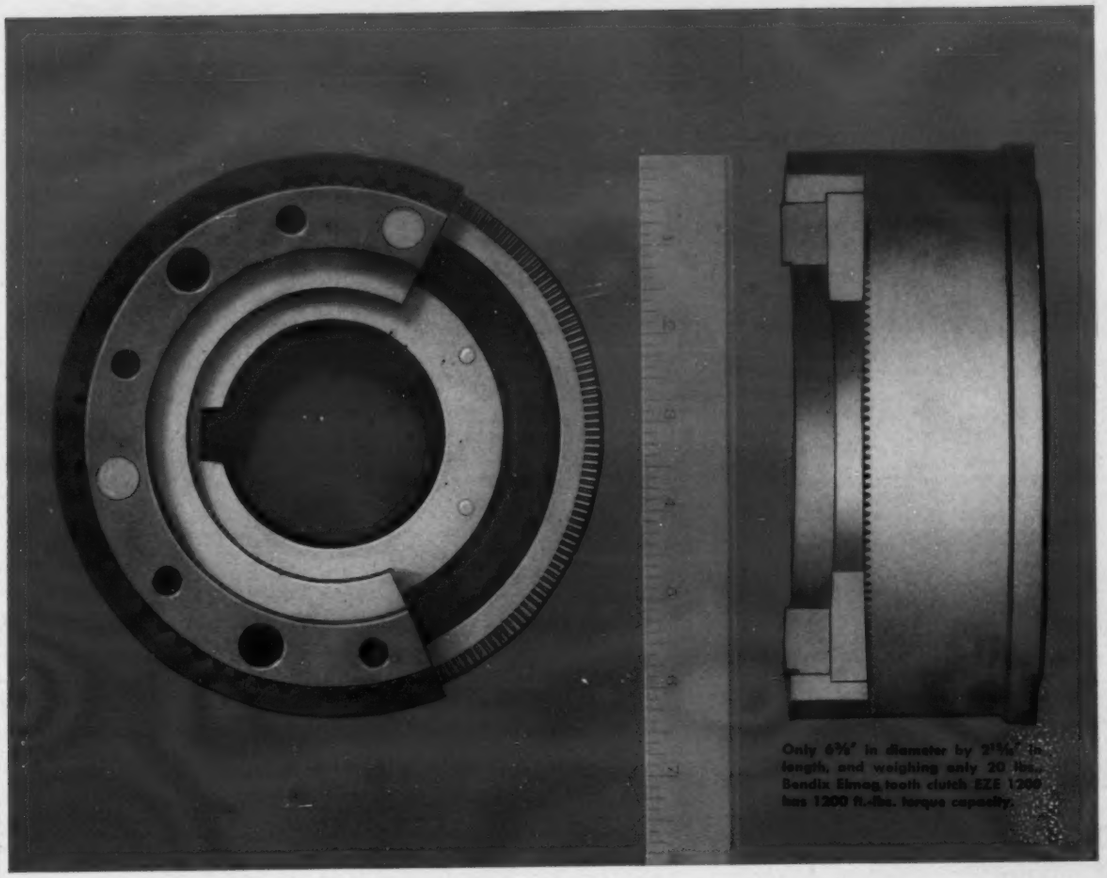
British Patent 849,253; Raymond S. Barton, The United Kingdom Atomic Energy Authority, London, England.

A vacuum valve covered by this patent is sealed by a cap with a sharp-edged skirt pressed into soft metal seating contained in a circular trough. Indium, indium-gallium or other low-melting point metal is used for the seating. After the cap has been operated many times, the seal effectiveness tends to deteriorate. To overcome the problem,



the soft metal surface is periodically reformed by heating with an electric element wound around the trough. The design eliminates gradual vacuum deterioration experienced with rubber and similar resilient seatings because of their high vapor pressure characteristic.

The cap is pinned to a rod carried in metal sealing bellows by a bossed plate. A knurled ring running on a threaded cylinder is secured to the plate by a clip.


Only 6⅜" in diameter by 2¹¹⁄₁₆" in length, and weighing only 20 lbs., Bendix Elmag tooth clutch EZE 1200 has 1200 ft.-lbs. torque capacity.

Designed for more torque in less space

BENDIX ELMAG* *(Electromagnetic)* TOOTH CLUTCH

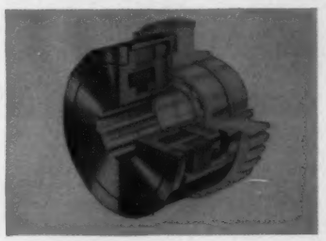
Machine designers now can provide for greater machine capacity, or space savings—or both—with the Bendix Elmag tooth clutch. This small, efficient package offers greater torque transmittal than is provided by other clutches of the same size.

It is more positive and simpler in design (only 3 parts) than other kinds of clutches. There is absolutely no idle torque—no connection between driving and driven members once disengaged. The Elmag can be disengaged under full load at any RPM, and engagement at relative speed is possible. The clutch's simple, bolt-on design makes it easy to mount; there are no additional splines or springs, no external disengagement mechanism.

*TRADEMARK

Elmag tooth clutches are designed to perform in either wet or dry applications. They are available from stock in torque capacities ranging from 40 to 4,000 ft.-lbs.

BENDIX ELMAG MULTIPLE DISC CLUTCH—Ideal for step-by-step acceleration of large masses. Disc stack is magnetically isolated. Wet or dry operation. Slip ring or stationary field design. Torque capacities: 10 to 16,000 ft.-lbs.



For full details, write

Bendix-Elmira
Eclipse Machine Division
Elmira, New York

THE Bendix CORPORATION

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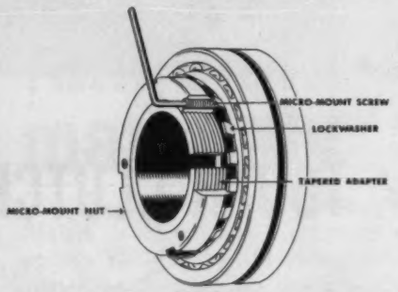
Exclusive MICRO-MOUNT



Fast and accurate mounting is made possible by the new Dodge Micro-Mount. The Adapter is snugged up with the Micro-Mount Nut. Mounting is completed by turning the Micro-Mount Screws against the Lockwasher until bearing, adapter and shaft form an integral unit.

Spher-Align

SPHERICAL ROLLER BEARING PILLOW BLOCK

Dodge, the nation's leading supplier of mounted bearings, presents America's newest spherical roller bearing pillow block . . . a rugged bearing in attractive modern design . . . inherently self-aligning . . . easy to install . . . easy to maintain . . . and featuring the unique Micro-Mount.

Its rugged housing of close-grained semisteel withstands shock loads. It has a generous lubrication reservoir—for oil or grease. And standardized dimensions make Spher-Align interchangeable with all other similar units.

Expansion and non-expansion types. Stocked for 2 7/16" to 8" shafts. Call your Dodge Distributor—or write us.

DODGE
of Mishawaka, Ind.

CALL THE TRANSMISSIONEER—your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look under "Dodge Transmissioneer" in the white pages of your telephone directory, or in the yellow pages under "Power Transmission Equipment."

DODGE MANUFACTURING CORPORATION
300 Union Street, Mishawaka, Indiana

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PATENTS...

Free-Piston Compressor-Burner

French Patent 1,232,281; Alexander Louis London, assigned to Ethyl Corp., New York, U.S.

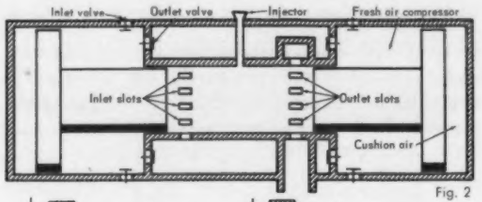
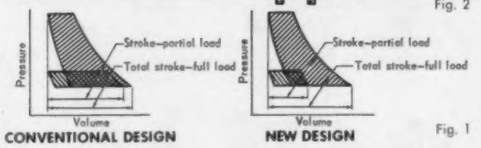


Fig. 2



CONVENTIONAL DESIGN NEW DESIGN

Fig. 1

This free-piston compressor-burner shows high efficiency, especially at idling speeds and light loads. Conventional free-piston compressor-burners for feeding gas turbines supply an excess of hot gases when only little power is required from the turbine, resulting in low efficiency (Fig. 2).

This invention increases efficiency. As seen in Fig. 1, two free pistons oscillate in opposed cylinders. On the outside of large pistons compressed air provides cushioning and rebound. Space between inner side of large pistons and cylinder is the fresh air compression space, while the small cylinder bore is the combustion chamber, with fuel injection at the central symmetry axis. When moved inward by compressed air cushion, the large pistons close the fresh air inlet valves and at preset compression ratio open the outlet valves. Compressed air flows through inlet slots to the combustion chamber, sweeps burned gases from previous explosion through outlet slots into exhaust manifold to the prime mover gas turbine. When both inlet and outlet slots have been closed, compression takes place in the small bore central cylinder, which ignites fuel injected at the end of the stroke. When this explosion projects the pistons outward again, slots are re-opened and hot gases mixed with compressed air again are fed to the exhaust manifold.

The new feature of this design is a very short power stroke with respect to the total stroke at full load. If load on turbine is decreased, less air is required from the compressor. This action is achieved by decreasing the total stroke of the pistons. In addition, by increasing the pressure in the cushion and rebound space on the outside of the large pistons, volumetric compression ratio can be increased for idling speeds, which further increases efficiency.

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YOU ASKED FOR IT!

WESTERN GEAR

VARI-MASTER

THE VARIABLE SPEED DRIVE YOU DESIGNED

WESTERN GEAR

Integral Type VARI-MASTER® *Variable Speed Drive*

for: 1 GREATER FLEXIBILITY 2 LATEST DESIGN IMPROVEMENTS 3 COMPACTNESS 4 INFINITELY ADJUSTABLE SPEEDS 5 MATCHLESS VERSATILITY 6 EASY MOTOR REPLACEMENT

The Vari-Master is a quality product with precision ground pulleys supported between bearings on an extra large diameter shaft. Both key and shaft are hard chrome plated and precision ground for extended pulley life with minimized fret corrosion and wear. The motor has its own cooling system independent of the cooling system of the Vari-Master transmission case. This allows for extended belt life and increased load factor. Pulleys are positive aligned to give automatic belt alignment. Tension spring for automatic correct belt tension and take up ▪ **Controlled speed for maximum production, increased machine efficiency ▪ Fast or slow speeds for varying load conditions ▪ Uniform rate of travel for machine surfaces ▪ A Vari-Master to meet your requirements**

Typical applications are tension, rate of liquid flow, speed controlling, rate of time for baking, drying, etc., in experimental laboratories for the control of processing materials.

Compare These Exclusive Features: 1. Compactness—maximum power in minimum space. **2.** Cooling fan for longer belt life.* **3.** Standard NEMA C motor with standard shaft. **4.** Hard chrome-plated shafts eliminate disc sticking.

* * *

Custom Design for Special Applications

Sanitary design—the majority of requirements are met with standard design; custom changes are available to meet specifics.

Corrosion resistant—with minor changes, Vari-Master can be converted to meet the unusual conditions for this type of application. Submit operating conditions.

Shaft high inverted design—for direct connected loads (non gear units). Submit your requirements or request dimensions.

Various type flanges—standard type flanges listed in catalog. Modifications or other types available. Submit details. Special design applications invited. Have Western Gear submit a solution to your variable speed problem with a custom-built Vari-Master.

* PATENT PENDING

Stan
"C"
Desi
Foot
Shov

Doubl
Greas

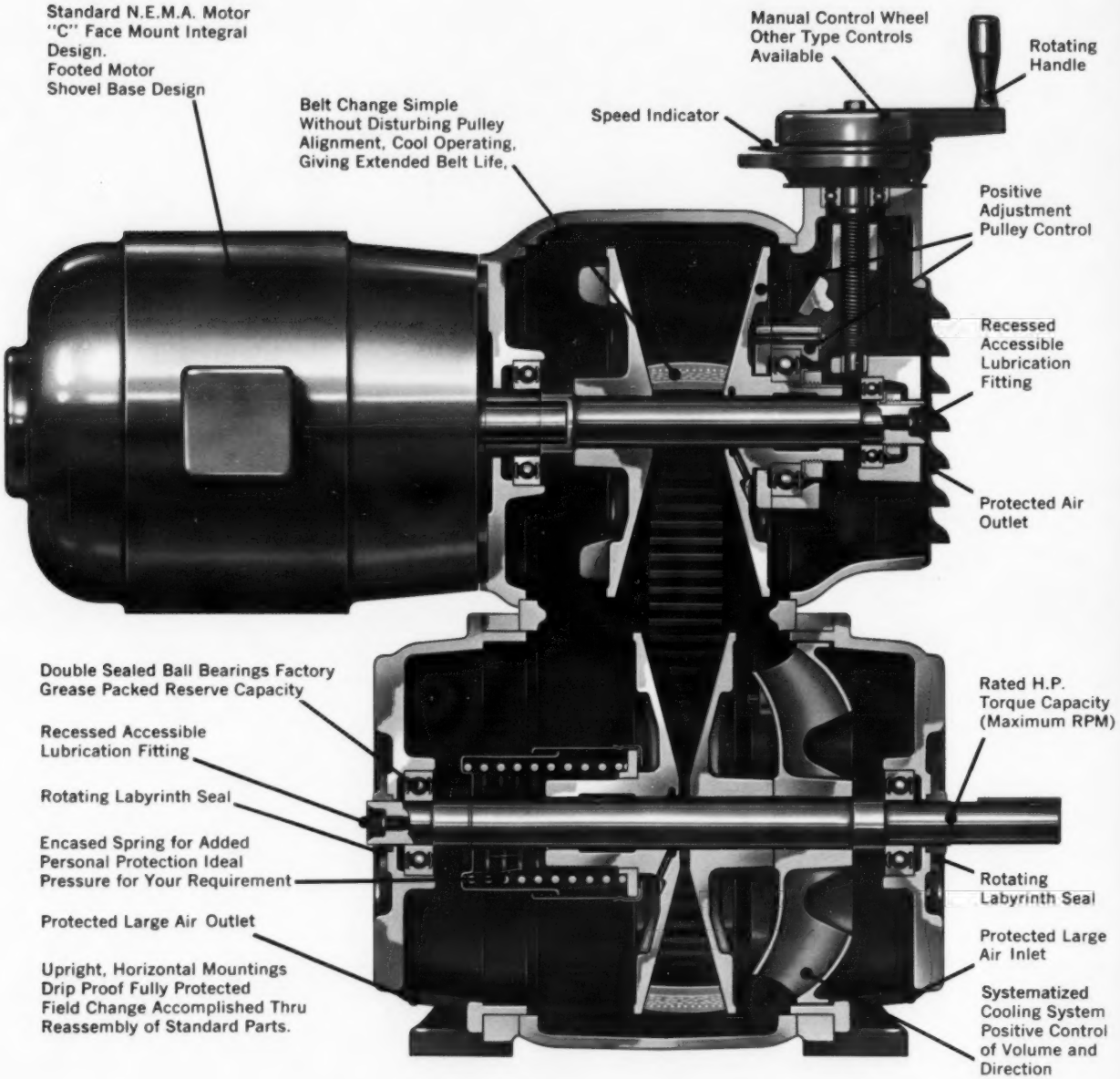
Reces
Lubri

Rotat

Encas
Perso
Press

Prote

Uprig
Drip
Field
Reass


Standard N.E.M.A. Motor
"C" Face Mount Integral
Design.
Footed Motor
Shovel Base Design
Belt Change Simple
Without Disturbing Pulley
Alignment, Cool Operating,
Giving Extended Belt Life.
Manual Control Wheel
Other Type Controls
Available
Rotating
Handle
Speed Indicator
Positive
Adjustment
Pulley Control
Recessed
Accessible
Lubrication
Fitting
Protected Air
Outlet
Double Sealed Ball Bearings Factory
Grease Packed Reserve Capacity
Recessed Accessible
Lubrication Fitting
Rotating Labyrinth Seal
Encased Spring for Added
Personal Protection Ideal
Pressure for Your Requirement
Protected Large Air Outlet
Upright, Horizontal Mountings
Drip Proof Fully Protected
Field Change Accomplished Thru
Reassembly of Standard Parts.
Rated H.P.
Torque Capacity
(Maximum RPM)
Rotating
Labyrinth Seal
Protected Large
Air Inlet
Systematized
Cooling System
Positive Control
of Volume and
Direction

VARI-MASTER
TYPICAL ASSEMBLIES

More than a quarter of a century of experience is designed into the Vari-Master with the features our customers want.

GREATER RELIABILITY—Precise machining and finishing techniques and careful heat treatment to uniform hardness are backed by Western Gear's uncompromising quality control methods. This means long life and quieter operation for the user. In addition, all units are full-load factory tested to insure complete reliability of performance.

EASIER MAINTENANCE—The Vari-Master variable speed drives have been designed for easy maintenance in the field. Housings are completely accessible from either end and sides, for ease of inspection and routine maintenance. Disassembly and reassembly is fast and simple, requiring no special tools.

FLEXIBLE INVENTORY—Western Gear has designed its line of Vari-Masters utilizing the "building block" principle. This results in a minimum renewal parts inventory because of parts standardization and a high degree of interchangeability.

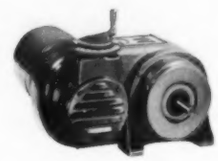
Vari-Master gearmotors, both integral and shovel base types, are offered in a wide variety of sizes and reductions.

Shovel Base Vari-Master • Upright Design • Double Reduction

Integral Horizontal Vari-Master Double Reduction

Shovel Base Upright Vari-Master Low Output Shaft • (No Gears)

Integral Upright Vari-Master Double Reduction



Integral Horizontal Vari-Master (No Gears)

Integral Upright Vari-Master Low Output Shaft • (No Gears)

Integral Vari-Master • Vertical Flange Mount • Double Reduction

Integral Upright Vari-Master Magnetic Disc Brake

Integral Upright Vari-Master Right Angle Gear Head

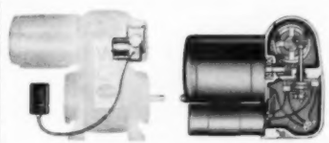
VARI-MASTER
CONTROLS

Easy access to control of the Vari-Master is assured regardless of the operator's working position. When the operator is working away from the control handle, or when the drive location is inaccessible, simple use of a mechanical or pneumatic control, or electrical accessories, assures complete and convenient control.

RAPID INTERCHANGEABILITY—Western Gear integral and shovel base type Vari-Master gearmotors and gearmotors are companion products which may be converted by simply interchanging packages in the field without disconnecting the gearmotor from its foundation or the driver shaft. Ease of changing ratio is another feature. This rapid interchangeability is important when unforeseen requirements for different output speeds or packages may arise.

UNIVERSAL COUPLING

CHAIN & SPROCKET



HEAVY DUTY REMOTE CONTROL MOTOR

RIGHT ANGLE DRIVE

DIRECT EXTENSION

PNEUMATIC CONTROLS

REMOTE SPEED INDICATOR

WESTERN GEAR CORPORATION

INDUSTRIAL PRODUCTS DIVISION • P.O. BOX 126, BELMONT, CALIFORNIA

Spring-Loaded Drive

U. S. Patent 2,963,135; Thomas J. Weir, assignor to Schwitzer Corp., Indianapolis, Ind.

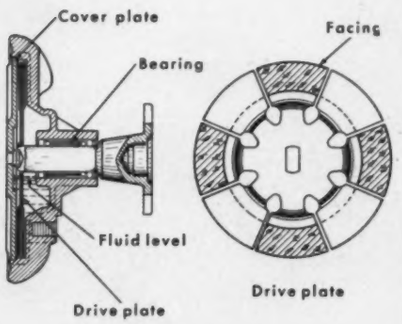
This spring-loaded fluid coupling is intended as an accessory driving device, such as an automotive cooling fan drive.

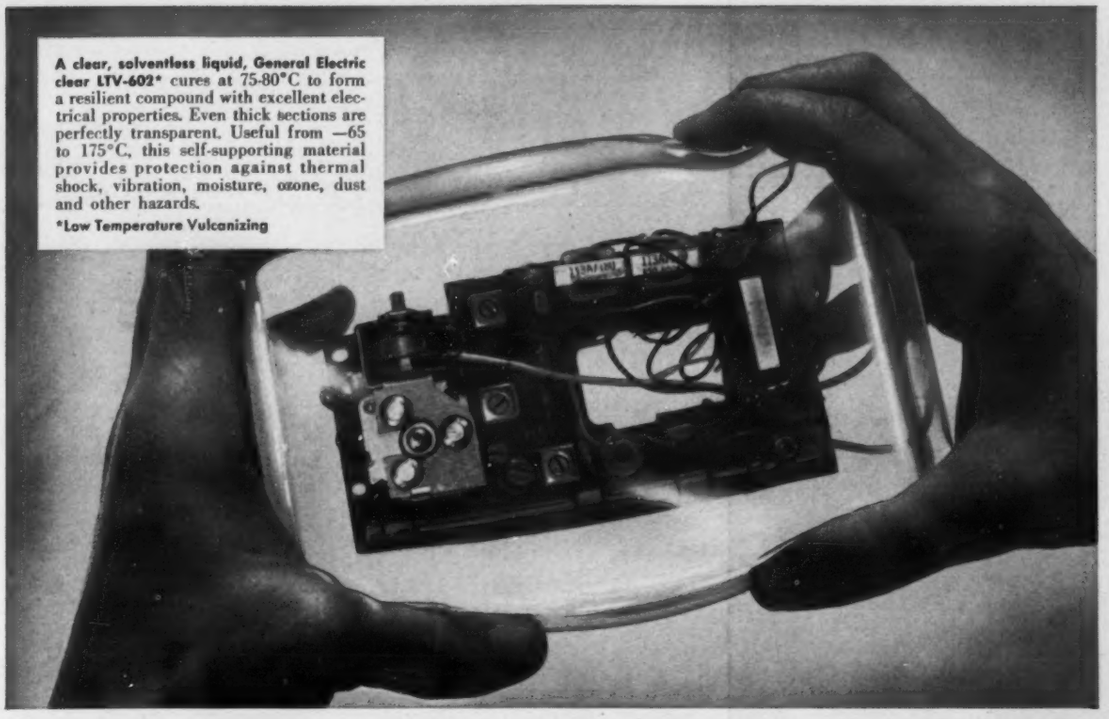
A drive shaft is adapted to be bolted to a fan pulley. A fluid housing consisting of a main section and a cover plate is bearing-mounted on the drive shaft.

The housing is formed so that a narrow peripheral chamber results. A disc-shaped rotor has a central truncated circular aperture which accommodates the end of the drive shaft, locked by a snap ring. The drive plate is formed of relatively thin metal. It is slotted radially to provide a series of spaced fingers which alternately extend in opposite directions out of the plane of the drive plate, and contain friction surfaces or facings. When installed in the housing, the fingers are deformed slightly. A high-viscosity fluid is introduced in the fluid chamber.

In operation, as the rotor is driven by the drive shaft, the fluid is distributed by centrifugal force into the narrow peripheral space. Since resilience of the fingers urges them against adjacent faces of the housing, frictional resistance developed at the area of engagement of the facings and the adjacent housing produces a substantially direct, non-slip drive.

As the drive shaft increases in speed, centrifugal force relieves pressure on the fingers and the plate rotates relative to the housing with torque being transferred from the drive plate to the housing by the resistance to shearing stress of the fluid in the chamber.



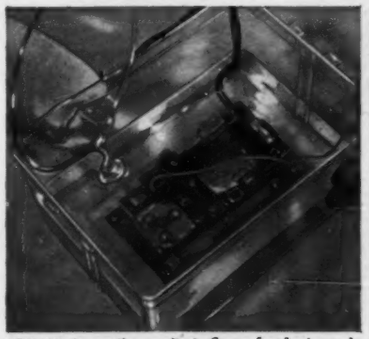


A clear, solventless liquid, General Electric clear LTV-602* cures at 75-80°C to form a resilient compound with excellent electrical properties. Even thick sections are perfectly transparent. Useful from —65 to 175°C, this self-supporting material provides protection against thermal shock, vibration, moisture, ozone, dust and other hazards.

*Low Temperature Vulcanizing

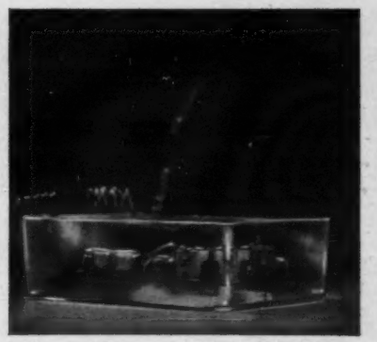
General Electric clear LTV silicone compound for potting and embedding

Transparent, resilient, self-supporting and easy to repair



LTV-602 is easily applied, flows freely in-and-around complicated parts. Having a low viscosity in the uncured state, 800-1500 centipoise, LTV is ideal for potting and embedding of electronic assemblies. Unlike "gel-like" potting materials, LTV-602 cures to a flexible solid. Oven cure is overnight, or from 6 to 8 hours at 75 to 80°C.

LTV-602 is easy to work with and easy to repair. To repair parts embedded in LTV, merely cut out and remove section of material, repair or replace defective part, pour fresh LTV into opening and cure. Pot life, with catalyst added, is approximately 8 hours and may be extended with refrigeration. When desirable, LTV may also be cured at room temperature.



Resiliency offers excellent shock resistance. LTV-602 easily meets thermal shock tests described in MIL-STD-202A test condition B which specifies five temperature cycles from —65 to 125°C. Tests indicate that LTV retains protective properties even after 1800 hours aging at 175°C. Other tests confirm LTV's resistance to moisture and water immersion.

LTV-602 is the newest addition to the broad line of G-E silicone potting and encapsulating materials which also include the RTV silicone rubbers. For more information, write to General Electric Company, Silicone Products Department, Section D340, Waterford, New York.

GENERAL ELECTRIC

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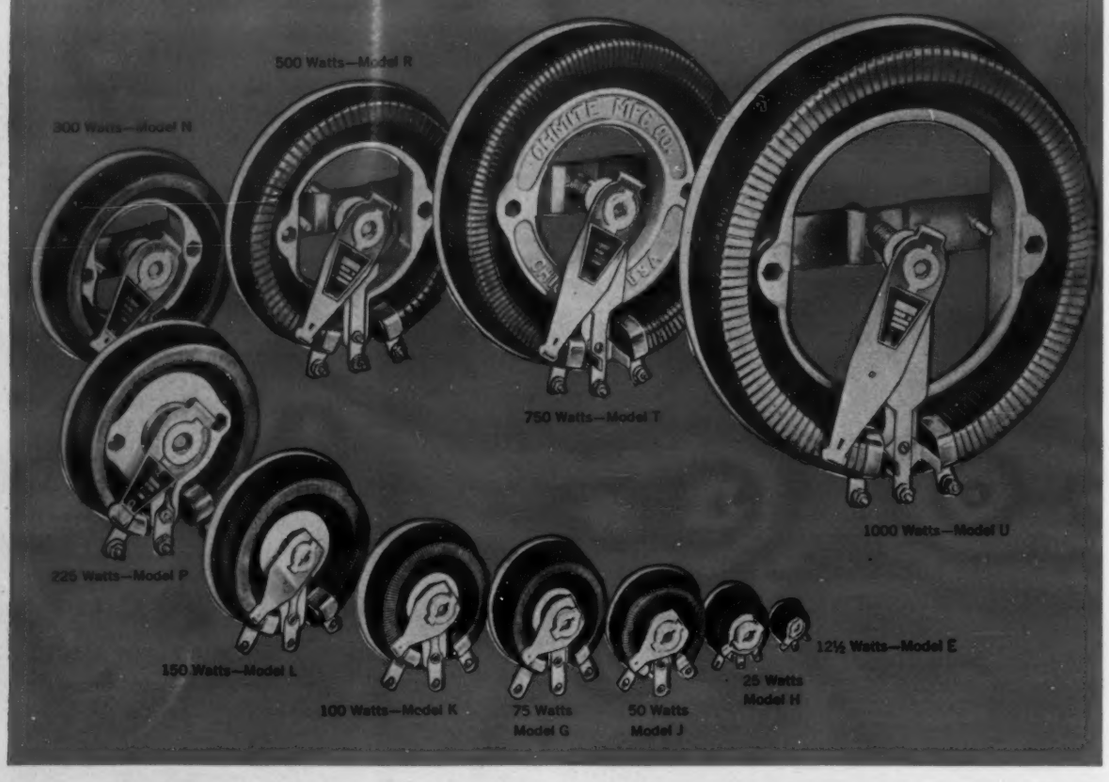
World's Largest Selection

SIZES • VALUES • STOCK UNITS • SPECIAL FEATURES



OHMITE offers the largest and most varied assortment of power rheostats ever developed.

You can choose from 413 *stock* commercial sizes and types ranging from 12½ to 1000 watts . . . or from over 400 *stock* MIL-R-22A sizes and values, with "special fast delivery" on *all* other MIL units. You can find, for example, scores of different shaft styles, sizes, configurations—already engineered and waiting. Literally, hundreds of other special features take care of any rheostat application envisioned today.

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Variable Transformers
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Relays
R.F. Chokes
Germanium Diodes
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PATENTS...

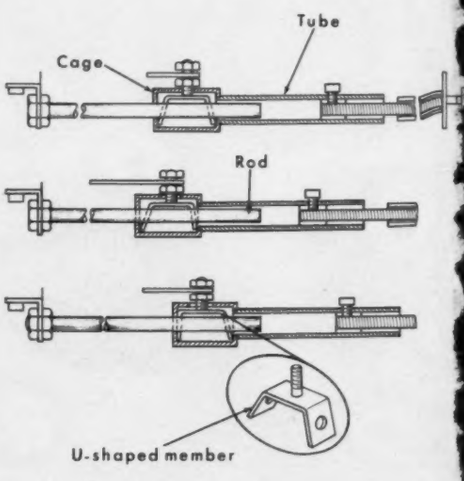
Linear Irreversible Mechanism

U. S. Patent 2,959,982; Alvin A. Cadwallader, assignor to Teleflex Inc., North Wales, Pa.

This control device is suitable for adjusting position of various elements from a remote location. The device automatically locks to prevent inadvertent movement in an opposite direction.

The motion transmitting portion of this device consists of a flexible cable within a guide conduit. The locking portion consists of a rod secured to a bracket by two nuts, and a U-shaped resilient sheet metal member. This U-shaped piece is disposed on the rod and is formed with a pair of leg portions connected by a mid-section. Each leg portion has a hole with a diameter similar to the diameter of the rod. When the leg portions are inclined slightly to the axis of the rod, the edges of the hole bite into the rod.

A pin is welded to the mid-section of the U-shaped piece, which is contained in a cage structure secured to a tube. The flexible cable is fastened to one end of the tube by means of a screw or other fastening device. An elongated slot is provided in one side of the cage structure to accommodate the pin attached to the U-shaped part. When the flexible cable is moved in either direction, the cage also is moved in that direction and one leg of the U-shaped piece is deflected until it is substantially perpendicular to the rod. When this occurs, the entire mechanism may be shifted along the rod. When the movement is complete, the resiliency of the sheet metal member causes it to lock against the rod and prevent further motion in that direction.



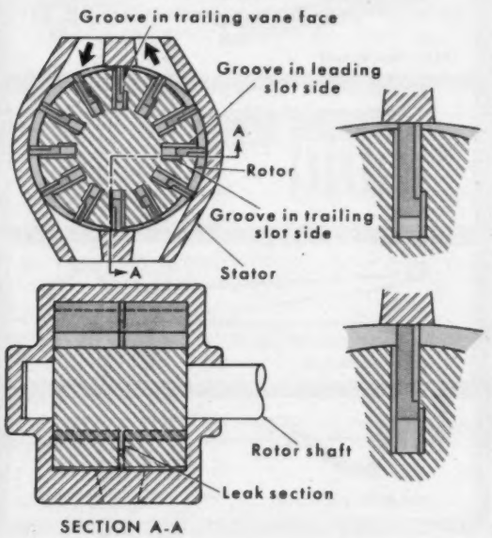
Volumetric Pump

French Patent 1,232,183; Shell Internationale Research Maatschappij N.V., The Hague, Holland.

In this radial-vane, double-action pump, wear is decreased by allowing very small leakage between the high- and low-pressure faces. An essential feature of the invention is that this leakage flows through the bottoms of the vane slots.

Small grooves in the high-pressure sides of the slots admit fluid to the spaces under each vane, between vane and rotor. Thus, vanes are forced outward against the housing not only by centrifugal force, but also by the pressure generated by the pump itself. Cavitation in the bottoms of the slots, which frequently occurs in conventional designs during outward motion of the vanes, is avoided and its destructive action is suppressed.

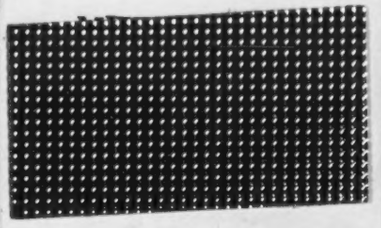
When a vane has passed the discharge orifice and is placed between it and the adjacent inlet, pressure conditions on its faces change. The vane is at its most inward position with respect to the rotor and opens an additional groove on its trailing face. Combined with the groove in the leading side of the slot, this places the bottom of the slot in connection with the aft space, allowing a small leakage to occur. The precise effect of this leak is not well understood, but it seems that it prevents vibration of the vane and decreases wear at the sensitive point between inlet and discharge orifices, where good surface condition is most essential for maintaining pressure ratio and volumetric efficiency of the pump.



26

EMBOSSED DESIGNS IN 6 METALLIC COLORS...

BACK PEELS OFF FOR ADHESION ▼



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PRESSURE SENSITIVE MIRRO-BRITE "MYLAR"* IN ROLLS SHEETS STRIPS DIE CUTS

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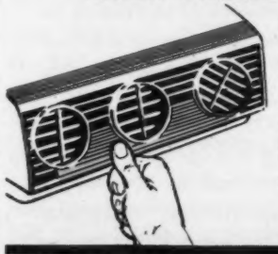

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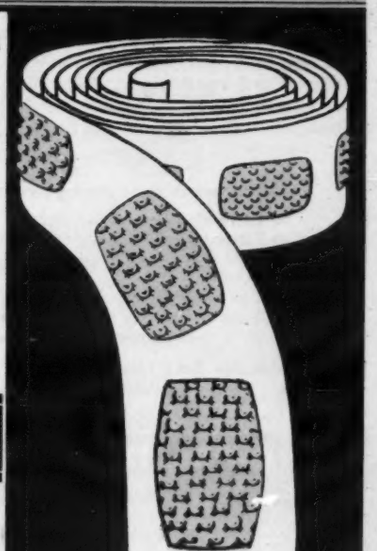

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"PIONEERS IN METALIZED MATERIALS"

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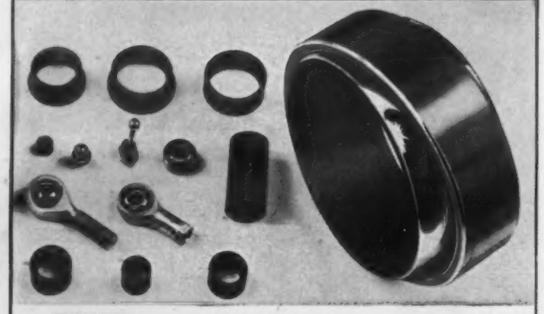
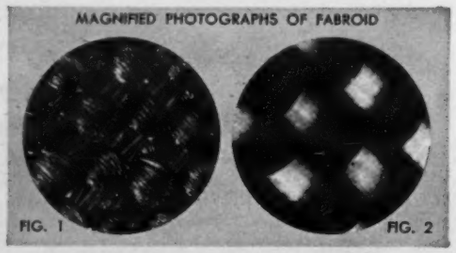
FABROID Self-Lubricating BEARINGS



REDUCE . . .
costs, wear, maintenance, and friction

PROVIDE . . .
reliability, weight-saving, nearly-equal starting and running coefficients of friction

ELIMINATE . . .
lubrication, fretting, brinelling, use of seals



10X-STRENGTH PROVIDES MAXIMUM LIFE FOR LOW-SPEED, HIGH-LOAD APPLICATIONS

FABROID consists of two fused layers. The bearing layer (Fig. 1) is a weave of Teflon* fibers interwoven on the back with a layer of phenolic-impregnated glass fibers of high tensile strength (light strands in Fig. 2).

Bonding the two layers under pressure and elevated temperature results in a dense lattice of self-lubricating Teflon fibers which have ten times the strength of other Teflon forms.

E. I. Dupont's Tetrafluorethylene

FABROID solves these bearing problems . . .

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- Extreme temperatures
- Tight space, weight conditions
- Abrading, galling, or corrosion
- Contamination
- Static Friction
- Shock and vibration

There Is No Substitute For Fabroid Bearings
U.S. Pat. No's. 2,804,886; 2,835,521; 2,885,248

MICRO-PRECISION DIVISION
Micromatic Hone Corporation
1535 Grande Vista Ave.
Los Angeles 23, California
PHONE: ANgeles 3-6142.

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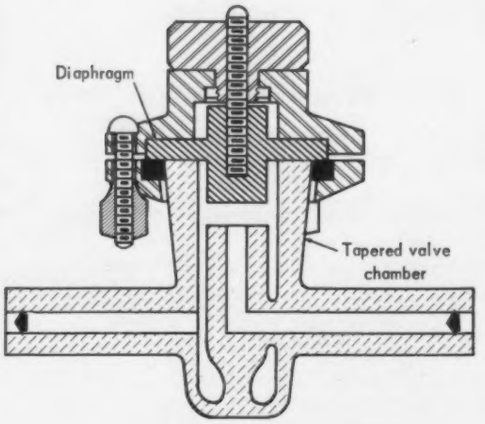
PATENTS . . .

Reactive-Fluid Control Valve

British Patent 843,094; Harry Lee, Dept. of Chemistry, King's College, Strand, London, W.C. 2, England.

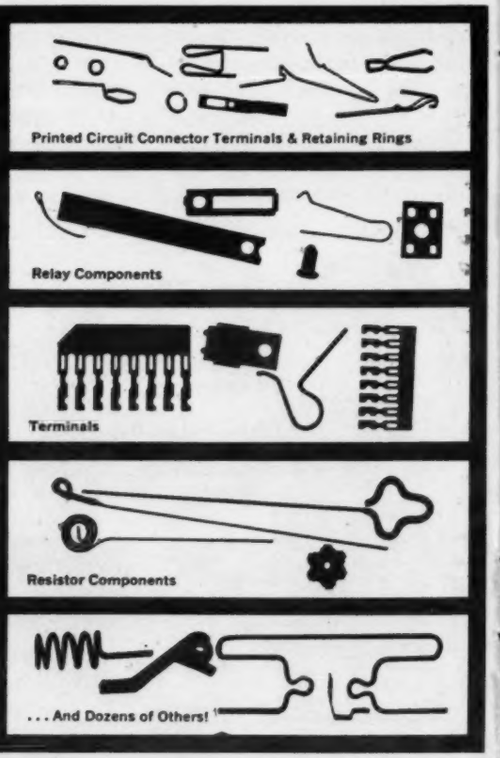


Glass and inert plastic material are used in this valve for parts which are contacted by reactive fluids at high positive or negative pressures. The glass, externally tapered valve is of one-piece construction. The inlet tube is bent at right angles to locate its end within the chamber. The bend is supported by a solid pillar extending from the chamber base to withstand high closing pressure.

Clamped between valve cover and chamber is a thick silicone-rubber, fluorocarbon rubber or polytetrafluoroethylene diaphragm. A central projection on the diaphragm is hand-adjusted through a spindle in relation to the inlet tube orifice to regulate the flow.

Gas-tightness between chamber and cover is provided by a connecting ring and graphite-impregnated asbestos gasket. Ring internal diameter slightly exceeds the tapered chamber's greatest external diameter. A recess in the ring accommodates the gasket, which has a slightly smaller internal diameter than the largest external diameter of the chamber. Both the ring and gasket are pushed onto the taper until the gasket closely embraces the chamber rim. Then they are secured tightly by flange bolts to improve the seal formed around the thickly tapered chamber end. Since lubrication is unnecessary, the valve can be operated over a temperature range from —80 to + 250C. No metal is contacted by the reactive fluid passing through the valve.

CUSTOM
ELECTRONIC
COMPONENTS
ENGINEERED WITH: CREATIVITY
INGENUITY • PRACTICALITY



Representative *custom* components pictured at the right are typical of the precision electro-mechanical parts manufactured by Stanley-Humason, Inc. for the electronics and electrical industries.

Can we serve you in this capacity?

For additional information, write for your copy of Stanley-Humason's 4-page circular, "Component Parts" . . . better still, send us your prints or samples for prompt quotations.

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The following list compiled from recent issues of the Patent Gazette gives you increased coverage of new patents whose details may be useful to product and machine designers. Copies may be obtained from the U. S. Commissioner of Patents, Washington, D. C. The price is 25c each.

ENGINE SYNCHRONIZING MECHANISM WITH HYDRAULIC ACTUATION
U S Patent 2,970,442; S. Blackwell Taylor, Cleveland, Ohio.

MECHANICAL VIBRATION GENERATOR
U S Patent 2,970,487; Theodore Ongaro, assignor to International Research and Development Corp.

ACTUATOR
U S Patent 2,970,496; Rudolph H. Kiessling, assignor to Square D Co., Detroit, Mich.

MAGNETICALLY DRIVEN PUMP
U S Patent 2,970,548; Sven Gustav V. Berner, assignor to Aktiebolaget Pumpindustri, Goteborg, Sweden.

FLUID FLOW INDICATORS
U S Patent 2,970,561; George A. Ashwood, assignor to the United States of America as represented by the Secretary of the Navy.

MULTIPLE INPUT HYDRAULIC AMPLIFIER
U S Patent 2,970,575; Hansjoerg Stern, assignor to General Electric Co., Schenectady, N. Y.

CONTINUOUSLY VARIABLE MECHANICAL TRANSMISSIONS
U S Patent 2,970,613; Frederick Baines, assignor to The Plessey Co., Ltd., Ilford, England.

STROKE CONTROLS FOR HYDRAULIC SYSTEMS
U S Patent 2,970,655; Russel D. Acton, Joliet, Ill.

TORQUE-LIMITING CENTRIFUGAL CLUTCH
U S Patent 2,970,680; Dallas E. Cain, assignor to General Electric Co., Schenectady, N. Y.

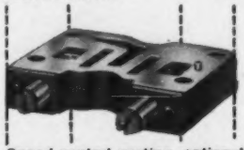
WEAR ADJUSTER FOR MAGNETIC FRICTION DEVICES
U S Patent 2,970,681; Wesley E. Timmcke, assignor to Warner Electric Brake & Clutch Co., South Beloit, Ill.

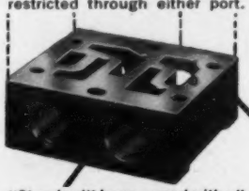
ROTARY COMPRESSORS
U S Patent 2,970,748; Wilfrid H. Bendall, New York, N. Y.

VALVE SEAL
U S Patent 2,970,803; Richard D. Harza, assignor to Harza Patents, Chicago, Ill.

MOLDED BEARING
U S Patent 2,970,869; Paul P. Thomas, assignor to American Metal Products Co., Detroit, Mich.

This basic CC body is the "heart" of every CC valve. Its one moving part is the "spool poppet", a Hannifin exclusive that seals bubble tight at either end of its short stroke. Note the ample air passages—all ¼" IPS or larger. This is single-actuator, spring return version.

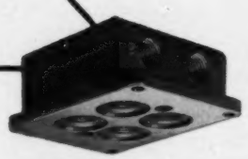

Speed control section, optional—designed to restrict exhaust flow, only, through either or both cylinder ports. Flow to the cylinder remains completely unrestricted through either port.


"Standard" base—used with all but foot-operated models. Every CC base is available tapped either ¼" or ⅜" IPS.

Optional base for "O" ring gasket mounting. Supplied complete with 4 O-rings.

This is the same body with double-end "spool poppet"—used when two actuators are required.

For foot-operated valves, the actuator is also the base, and this rear-ported adapter is used. Available tapped either ¼" or ⅜" IPS.


"Universal" base, tapped from beneath and from both sides. Four pipe plugs supplied. Can also be used with O-rings.

THESE QUICK-RESPONSE 4-WAY VALVES MOVE AIR DOWN THE LINE—FAST!

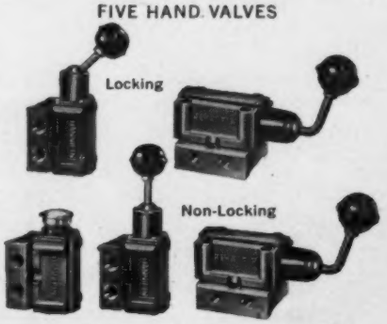
Hannifin CC valve design is the reason. Short, positive strokes of the "spool poppet" open up instant and ample passages for air.

Actuation? Any way you want it!

One basic body with a wide selection of operating heads and bases—all with or without our new speed control section—give you over 3,000 choices. We can help you make the right choice . . . through our field engineering service. Call your nearest Parker-Hannifin office or write us direct for full information.

SINGLE ACTUATORS
(Spring Return)

FIVE HAND VALVES



TWO FOOT VALVES

TYPICAL COMBINATIONS
(Hundreds Available)

FOOT-OPERATED, LOCKING; PRESSURE OVER-RIDE —used on foundry machinery
CAM-OPERATED; PRESSURE-RETURN —used on automatic wash tanks
DOUBLE SOLENOID —used everywhere
PRESSURE-OPERATED; PRESSURE-RETURN —used everywhere

HANNIFIN COMPANY
A DIVISION
535 South Wolf Road • Des Plaines, Illinois
PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS

3138 PH.

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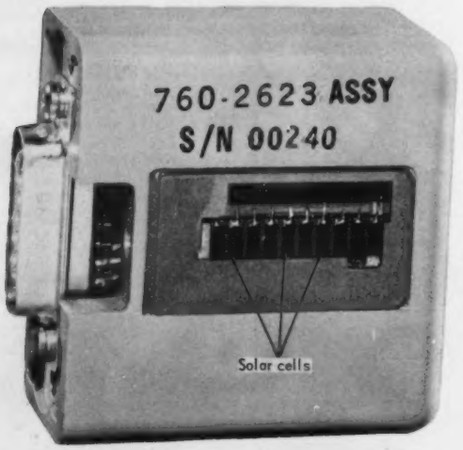
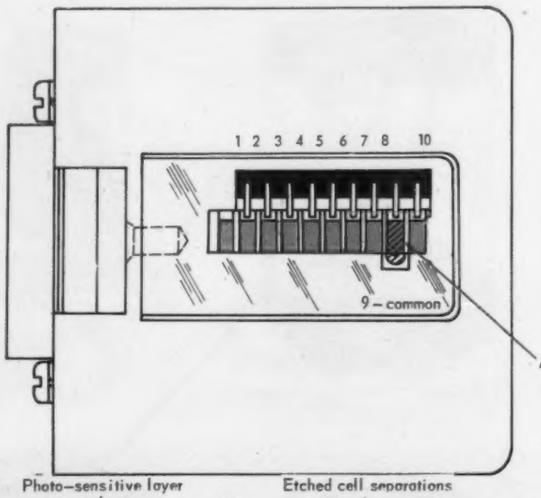
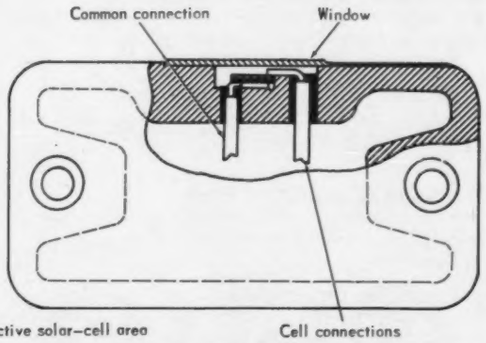
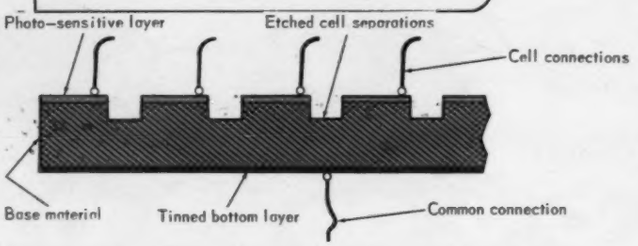
Solar Cells Provide High Reliability in Punched-Tape Reading Head

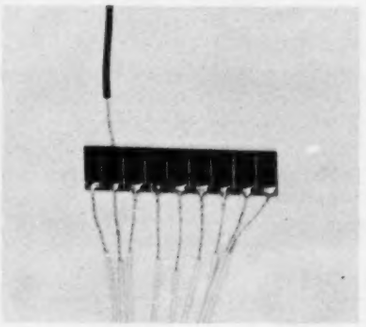
Lars G. Soderholm, Midwest Editor



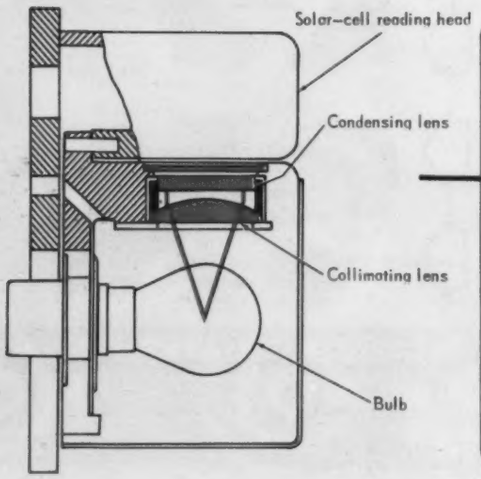


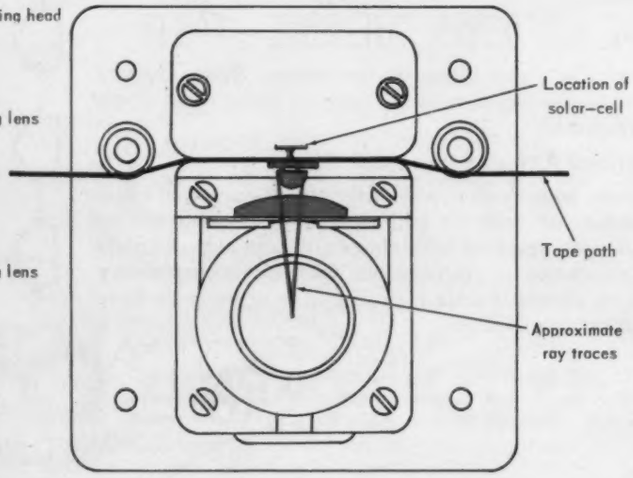




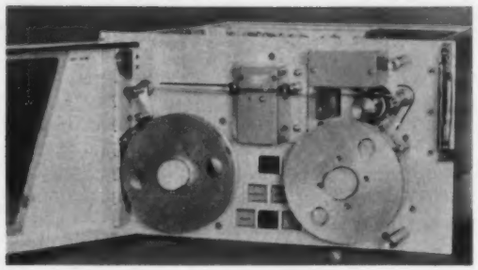


PHOTOCELLS are made from single strip of silicon base material that has a photo-sensitive layer over it. Etching process is used to separate individual cells. Soldered tin strips provide top connections to each cell. Bottom surface is tinned and one common connection is used. Cells are coated with protective plastic material to provide protection before and during assembly. Photocells are sealed hermetically and mounted in cast reading head. Units are interchangeable.





OPTICAL SYSTEM uses prefocused bulb with filament operating at reduced voltage for increased reliability. Collimating lens directs light through cylindrical convex lens that throws line of light across tape surface.



A tape transport, designed for reliable operation over wide ranges of temperature and humidity, uses silicon solar cells to sense the punched tape pattern. The solar cells, all etched from a single strip of material, provide high signal-to-noise ratio and withstand extreme environmental conditions such as high temperatures or light levels.

The photo-electric tape reader offers several advantages over a mechanical reader. Among these is higher reliability because of fewer parts, of which none is subject to wear. Also, it is not limited to slow tape speeds (2 inches per second), does not have a contact-wear problem and, when measured in terms of reliability, is relatively insensitive to dust.

The light source for the tape reader forms a line of light 0.015 inch wide across width of the tape. This is done by using a prefocused bulb which precisely locates the bulb filament.

A collimating lens and a cylindrical convex lens complete the precision light source assembly. Line of light of uniform intensity is focused on the tape surface. The tape acts as a shutter as it passes between the light source and reading head containing the solar cells.

The reading head must distinguish between "hole" or "no-hole" conditions in the standard 5-, 6-, 7- or 8-level codes punched 10 holes per inch along and across the tape at all tape speeds up to 15 inches per second. The solar cells are mounted and sealed in a cast reading head. The read head output is fed into transistorized, direct-coupled amplifiers having an output voltage swing of 10v "hole" to "no-hole".

The reader can be used in computer, communication or control applications. The machine takes up to 625 ft of tape on 5-inch reels and can provide metered tape speeds up to 20 inches per second. Output circuits are capable of delivering any output voltage of either polarity up to 15 ma at 10v maximum.

The Model 81 "Transport" is made by the Data-Stor Div., Cook Electric Co., Skokie, Ill.

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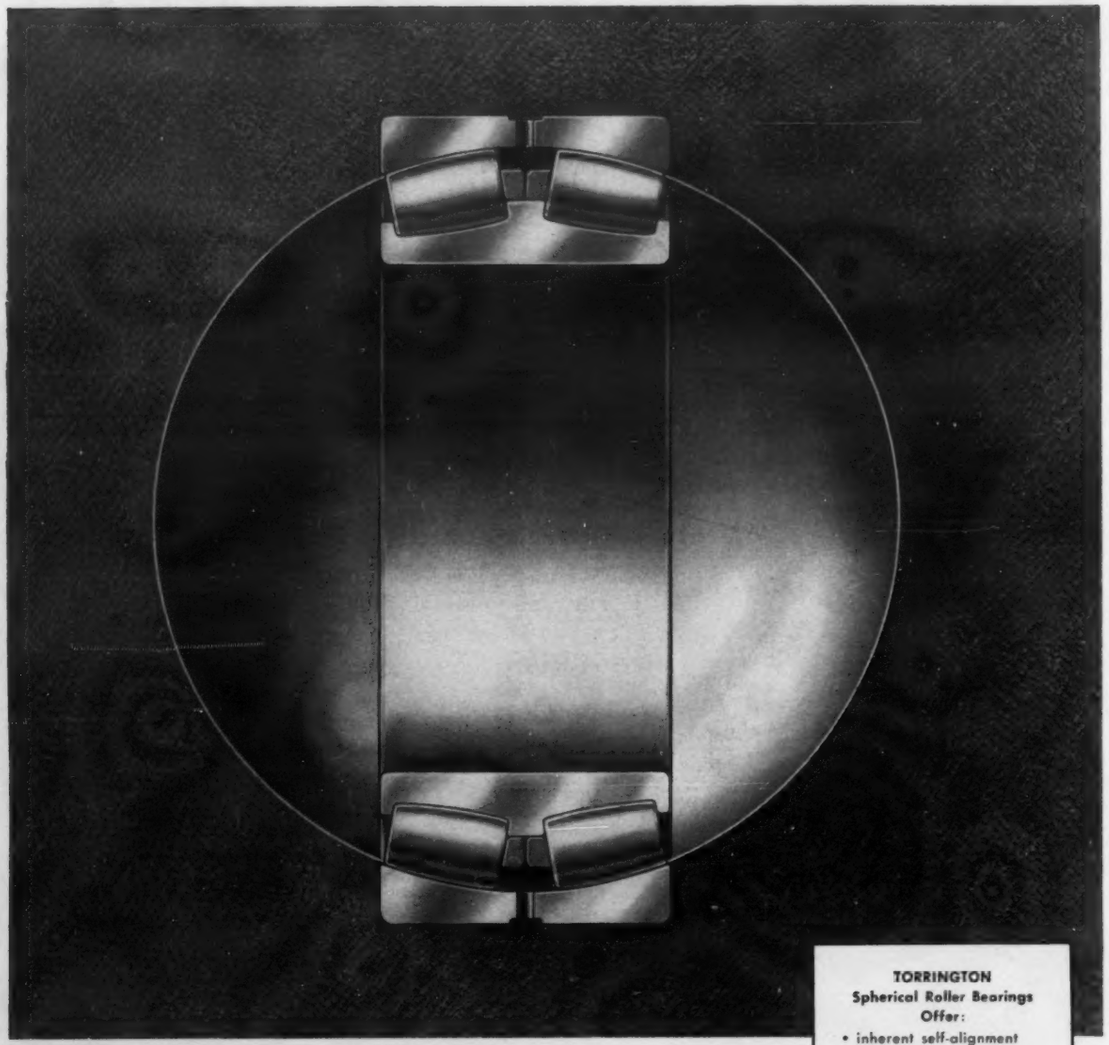

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IDEAS . . .

ELECTRICAL DEVICES

Disc Electrodes

Edward W. Schrader, Western Editor

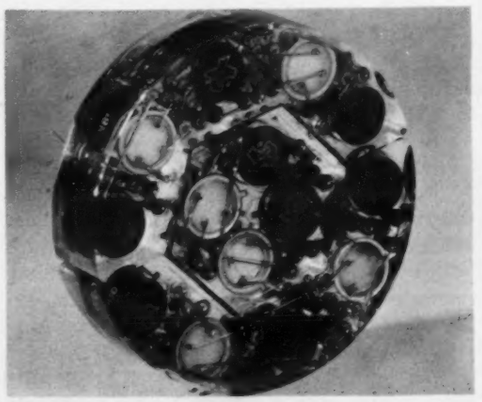
Disc electrodes butt weld leads to standard electronic component lead material. Pairs of discs clamp the weldable lead and the already shortened lead on the component. Linear ball races permit one electrode assembly to move horizontally for in-line abutment.

Welding provides a means of packaging the existing electronic components in a minimum volume. Precision welding is considered a controllable process and the reliability of such a joint is much higher than that of soldering.

Production welding of component packages has not reached top efficiency, because of problems concerning the components themselves. Specifically, component lead wires are of varying materials—a diode lead wire may be copper-plated nickel-iron, a transistor lead may be gold-plated nickel-iron-cobalt, resistors normally are manufactured with tinned copper leads.

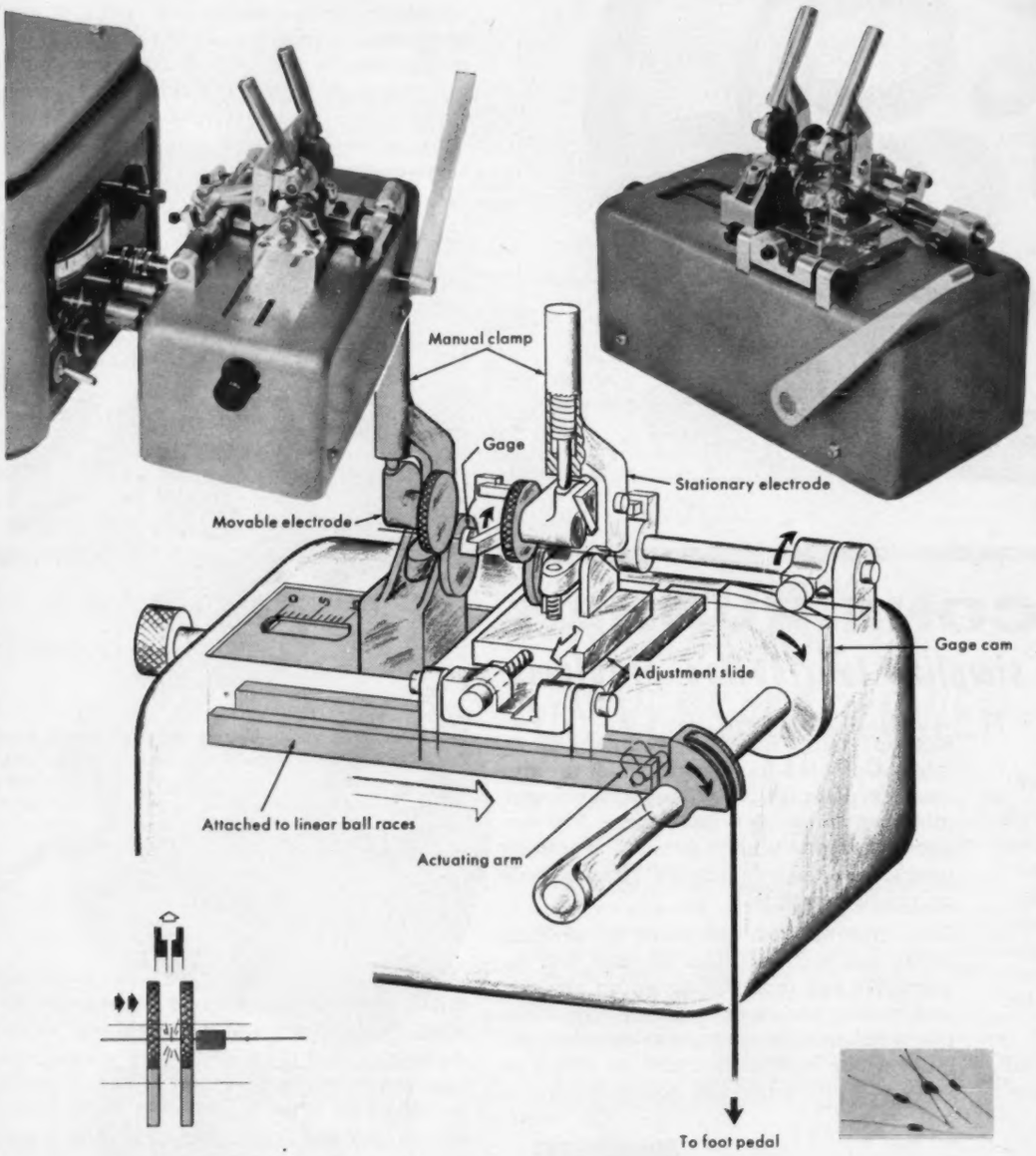
By use of a butt welder, new leads may be welded to these standard components. With one setting of a butt welder, all of a given batch of components may have their leads replaced with a nickel lead. These components then may be joined with a single setting for resistance welding of the nickel leads together in the proper circuit pattern.

The Model 1040 Butt Welder is a design development of Weldmatic Div., Unitek Corp., Monrovia, Calif.



ENCAPSULATED ELECTRONIC CIRCUIT MODULE has all-welded connections. Weldable leads are attached to components prior to welding components into circuit.

Join Weldable Leads to Existing Components



CAM-OPERATED gages move away from electrodes during weld operation. Gages permit correct amount of material overhang required for butt weld and follow-up. As operator actuates handle or foot-pedal, face of cam turns shaft. This motion causes gages to move upward to clear electrodes. Simultaneously, crank arm actuates spring-loaded movable electrode. Electrode assembly carries new lead up against component lead to effect weld. Butt welder accommodates wire sizes ranging from 0.008 to 0.040 inch dia. Materials are handled in horizontal plane. Assembly operator can set welding current and electrode force for entire production run.

MINIATURE!

1/12 HP *Oil-less* MOTOR COMPRESSOR AND VACUUM PUMPS

A dependable source of oil-free compressed air in a unit that fits in the palm of your hand! B&G 1/12 H.P. Oil-less Air Compressors and Vacuum Pumps have infinite applications for process agitation, instrument control and motive power.

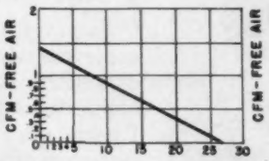
Free air delivered by this compressor far exceeds that of any current design of the same horsepower. It is capable of continuous operation at pressures up to 65 psi.

No chance of oil-spoiled work—*not a drop of oil* can be found in this compact, lightweight compressor. Motor and compressor are permanently grease-packed...carbon-graphite piston rings and skirts operate for years without injury to the cylinder walls. Since the cylinders are not oil lubricated, air is always oil-free—no oil separator needed—no costly lubrication maintenance.

B&G Oil-less Compressors are available in 58 models—send for literature.

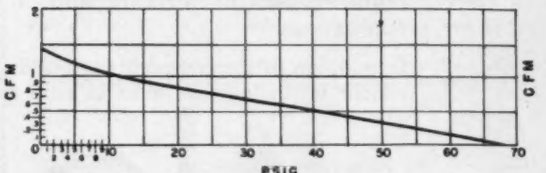
MODEL LV

VACUUM PUMP PERFORMANCE
VACUUM-INCHES OF Hg



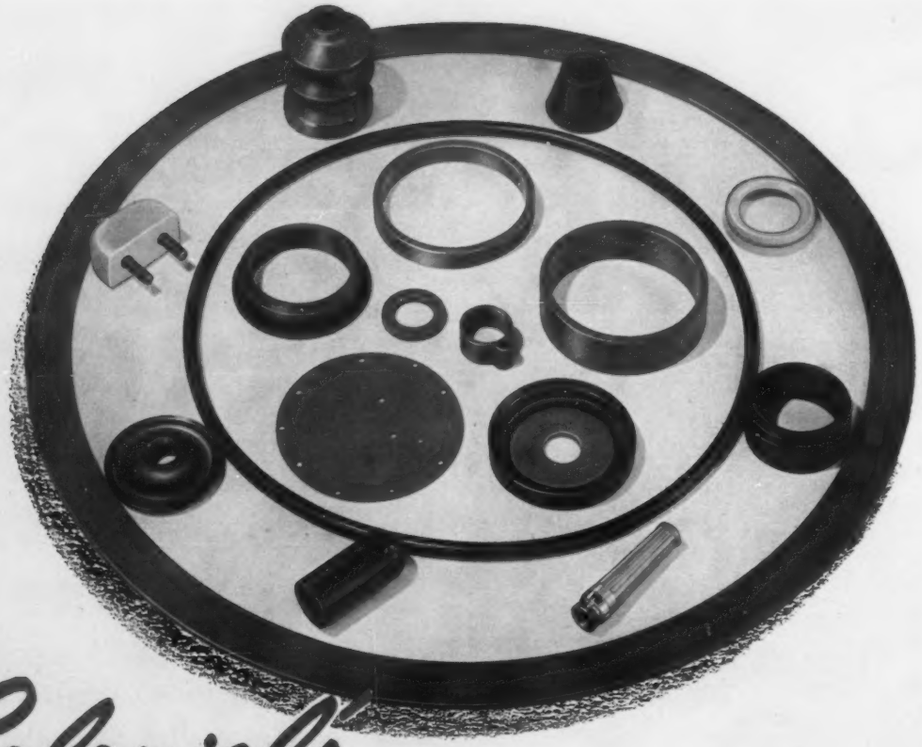
MODEL LC

AVERAGE FREE AIR DELIVERY AT VARIOUS PRESSURES



Oil-less
AIR COMPRESSORS
BELL & GOSSETT COMPANY
Dept. GO-18, Morton Grove, Illinois

Circle 52 on Reader-Service Card for more information



Colonials

"SILICOL"® SILICONE RUBBER

can improve your product and simplify fabrication problems

★ ***ANY MOLDED SHAPE***

★ ***ANY COMPOUND FORMULATION***

Colonial Rubber has a long record of achievement in using the unique properties of silicone rubber to meet "tough service" applications in all types of manufacturing. Particularly outstanding are the many special compounds our chemists have formulated to meet unusually rigid performance requirements in aircraft and missile applications.

In addition to the comprehensive industrial rubber technology we offer to help manufacturers solve rubber compounding problems. Colonial has large, modern and complete plant facilities to assure lower cost rubber molding and fabricating. We are *known* for our ability to meet manufacturer's "emergency" delivery requirements on priority projects.

Save time on your programs by sending prints and pertinent data on your *first* inquiry. We will promptly return an analysis and recommendations, together with illustrated information giving you complete details on our organization and its ability to serve you efficiently and economically.

1718-A

COLONIAL RUBBER CO.

706 Oakwood St. AXminster 6-9611

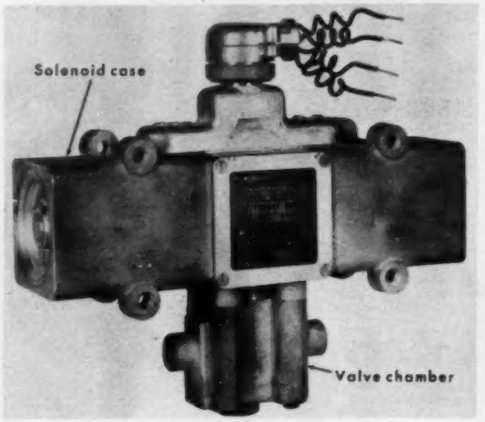
RAVENNA, OHIO

Circle 53 on Reader-Service Card for more information

Dual-Solenoids Operate

Celestino O. Lubatti, Italian Editor

The toggle arm of a two-way slide valve is thrown by opposed solenoids energized by very short electric impulses. A single-pole, double-throw switch cuts current off immediately after valve tripping. Unlike common solenoid valves, this design requires no current to hold valve open (or closed) and requires minimum operating power.

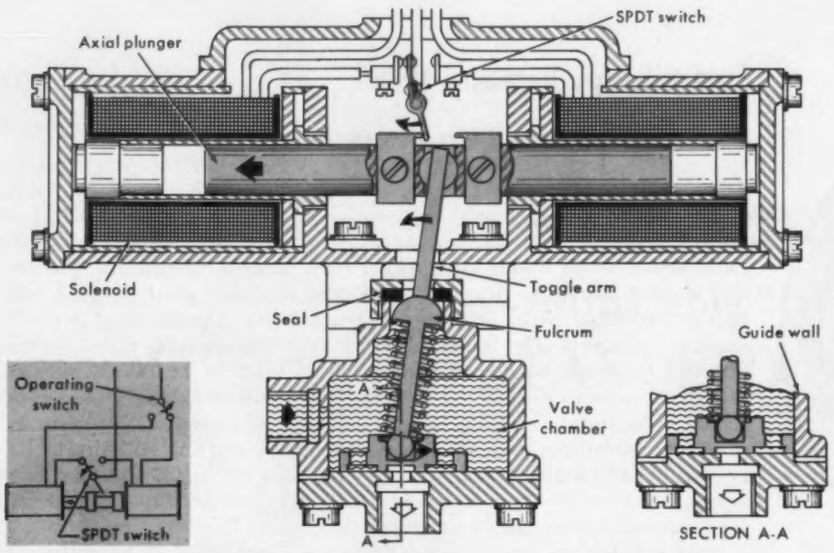


DUAL-SOLENOID VALVE draws less than 3.5 amps from 24v d-c line. When no limits in current absorption are set, length of solenoid case is reduced by ⅕. Valve is for ordinary fluids under less than 10 kg per sq cm (142 psi) pressure.

Valve chamber is separate and sealed to prevent fluid leakage into the solenoid case through the hemispherical fulcrum of the toggle arm. When the axial plunger is attracted by one solenoid, the toggle arm follows plunger movement and throws the valve slide to the opposite side. A coil spring relieves solenoids from further effort as the toggle arm passes over center.

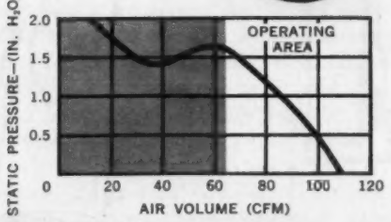
The SPDT switch is actuated by adjustable detents on the axial plunger to ready inactive solenoid for valve reversal. Duration of current impulses is limited by the length of plunger stroke. The valve is produced by Morrel Srl, Milan, Italy.

Valve through Toggle to Eliminate Holding Current



VALVE SLIDE LID is made of polytetrafluorethylene ("Teflon") to insure airtight adherence to bottom of valve chamber with minimum wear. It is square in shape and guided on side walls.

3" dia. x 3¼" long, 16 ounces



NEW VANEAXIAL

AC/DC UNIVERSAL BLOWER

Globe's VAX-3-GN Universal Blower gives you 110 cfm. free air, with a design point of 68 cfm. at 1.5" H_2O—on **either** 115 v.d.c. or 115 v.a.c., 60 cycle power. Other voltages can be supplied. Nominal speed is 14,000 rpm.

You can standardize on this extremely versatile blower for ground support and commercial electronic cooling. It's designed to meet MIL specs, having passed shock and vibration per MIL-E-5272. Production tooling makes this blower economical. Prototypes can be in your hands tomorrow (telephone BA-2-3741 for part no. 19A908); production orders normally delivered in a short time.

Rugged mechanical protection is provided by the black anodized aluminum housing and propeller. Mount by clamping to servo ring at either end. Nominal life exceeds 1000 hours. Max. current is 0.47 amps at free air delivery. Request Bulletin GNB from Globe Industries, Inc., 1784 Stanley Avenue, Dayton 4, Ohio.

GLOBE INDUSTRIES, INC.

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Barksdale AIR-SEAL* Valves for the nerve centers of production

The air pressure is the sealing force; the higher the pressure, the tighter the seal.

DIRECT SOLENOID 4-way, 3-way, shut-off and diverter valves

Standard **AC**

Explosion-proof **AC**

Standard **DC**

Explosion-proof **DC**

SOLENOID-PILOT 4-way and 3-way valves

Standard **AC**

Standard **DC**

Explosion-proof **AC**

Explosion-proof **DC**

MOMENTARY CONTACT solenoid-pilot valves

Single Solenoid

Both types available in standard AC and DC and explosion-proof AC and DC.

Dual Solenoid

MANUAL OVERRIDES for standard solenoid-pilot valves

"L" type manual override

"MK" type manual override

MANUAL and FOOT OPERATED valves

Manual 4-way

Manual shut-off

Foot operated 4-way

Write for air valve catalog (AV-9) which contains complete data and prices on 562 different valves (not counting voltage variations).

CONTROL VALVE DIVISION

Barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

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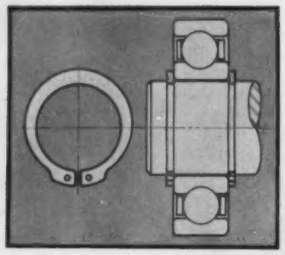
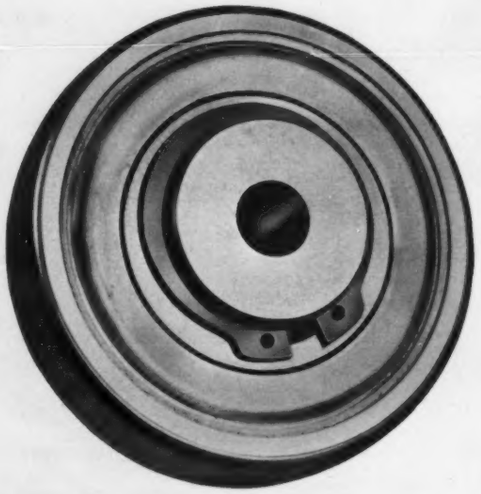
NEW PRODUCTS

For more information on products described, circle on the Reader-Service Card the numbers appearing opposite the story headlines and drop the card in the mail.

MECHANICAL





External-Type Retaining Ring 301

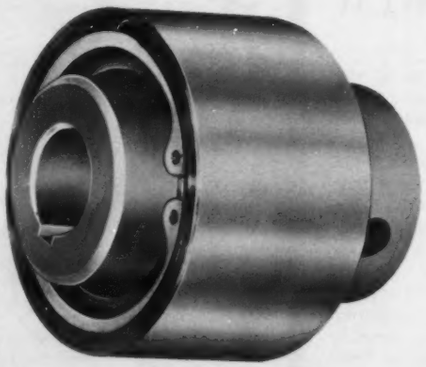
Provides High Thrust, Impact Capacity

A heavy-duty retaining ring provides a shoulder sufficiently high to retain parts having large corner radii or chamfers. Series 5160 may be used without spacer washers to secure ball bearings, tapered roller bearings and cylindrical roller bearings—all having large corner radii or corner breakouts. The ring may be used to replace heavy-duty fasteners, machined shoulders and other bulkier fastening devices used to secure components on shafts, axles or similar structural members. The locking device is currently available in eleven sizes designed for shafts ranging in diameter from 0.473 to 2.0 inches. Standard material is carbon spring steel (SAE 1065-1090); standard finish is oil-dip. For special applications requiring unusual corrosion resistance and/or resistance to high temperatures, rings are also available in Armco PH 15-7 Mo stainless steel. Rings for shafts ranging in diameter from 0.473 to 1.378 inches can be supplied also in beryllium copper. Stainless-steel and beryllium-copper rings are furnished without additional finish.

Waldes Kohinoor, Inc., Truarc Retaining Rings Div., 47-16 Austel Pl., Long Island City, N. Y.

Overload Protector Coupling 302

Operates for One Million Connect-Disconnect Cycles



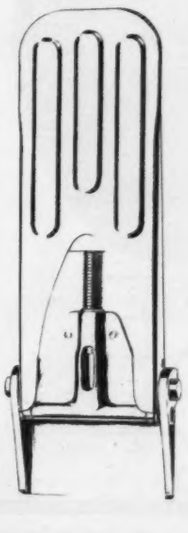
"Torq-Tender" fits motor and machine shafts from ⅜ to 1½-inch dia and may be ordered preset to disengage at any torque setting from ½ to 60 lb-ft. Unit can remain for an unlimited time in the disengaged position without overheating or binding. It automatically re-engages when overload is corrected, and motor is operated at low rpm or turned off and started again. Unit always re-engages in same position, so there are no timing problems. Coupling can be used either in direct drive or in attachment with sprocket, gear or pulley.

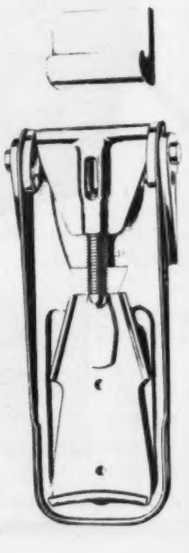
Helland Inc., Navarre, Minn.

Tension Latch 303

With Tensile Strength of 1000 Lb

An adjustable drawhook tension latch, designated 46L, 14 and 23, is designed for use on re-usable shipping containers, transit cases and other general-purpose latch requirements. Unit provides up to ½ inch adjustment with an ultimate tensile strength of 1000 lb. All models are completely interchangeable, with fixed drawhook latches, and design gives good load deflection characteristics without springs. Common pivot of both drawhook and handle prevents accidental opening due to vibration or buckling and misalignment of container sections.

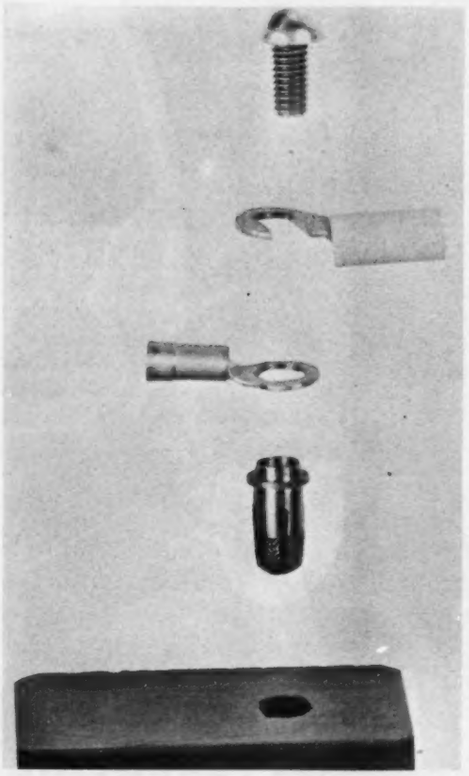




Camloc Fastener Corp., 52 Spring Valley Rd., Paramus, N. J.

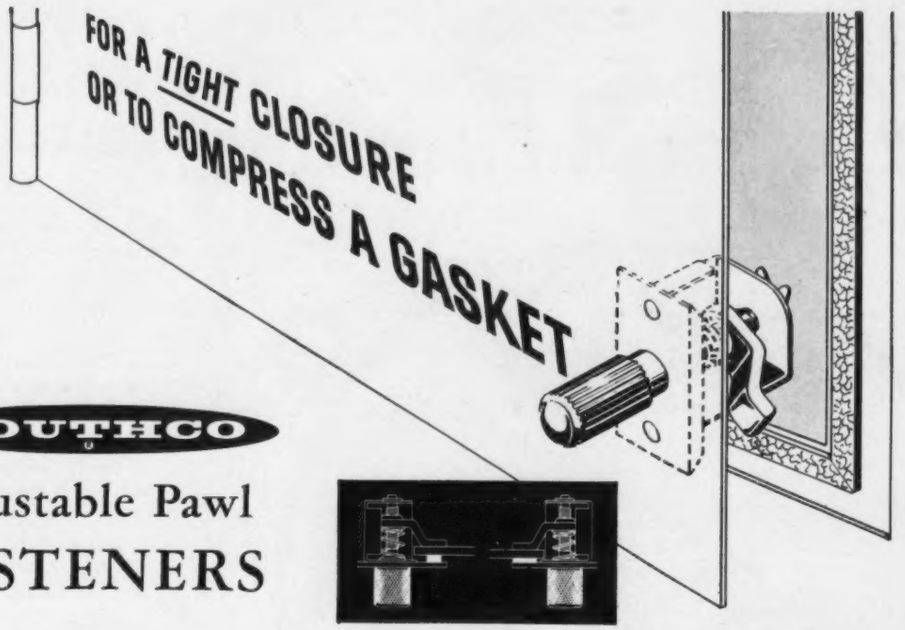
Threaded Insert 304

Accommodates Electrical Connection In Plastic



Installed in plastic parts after molding, this insert eliminates production problems commonly associated with molded-in inserts. An eyelet, which protrudes above surface of workpiece, is insert's primary feature. By placing a terminal or contact strip over eyelet and then crimping eyelet over terminal, a strong and good conductive electrical connection is formed. Lead wires may then be attached to connection by a conventional binding screw threaded into insert. The "Clinch Insert" provides substantial strength when properly installed. For example, a 6-32 insert provides a minimum of 18 lb-in of torque and an average of 240 lb pull-out strength. Since maximum recommended torque for a mild steel 6-32 bolt is 12 lb-in, insert provides a good safety margin. Inserts are available in sizes 4-40 through 8-32 with 0.040 and 0.065-inch eyelet heights, which will accommodate terminals with No. 6 through No. 10 holes in most popular thicknesses.

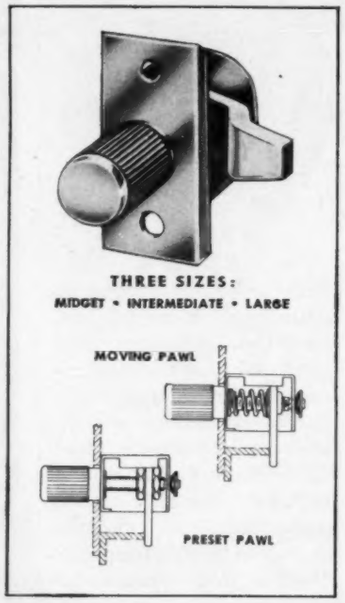
Heli-Coil Corp., Phelps Mfg. Div., Danbury, Conn.



SOUTHCO

Adjustable Pawl
FASTENERS

¼ turn closes—additional turning tightens



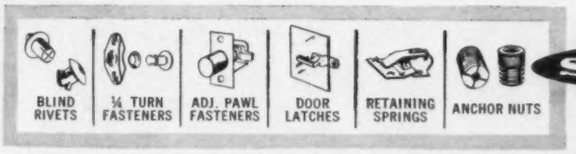
Just slip the knob through a hole in the door (any door thickness—it doesn't matter). Fasten with two rivets, bolts, or welds. The Southco Adjustable Pawl Fastener will fit your door frame, even when material gauge varies between units.

Turn the knob. The first quarter turn latches the door. Now keep turning. You're pulling the door tightly against its frame. You can compress a gasket, form a dust or moisture seal, overcome vibration.

You'll save installation time and satisfy your customers with these rugged, attractive, pre-assembled fasteners. Ideal for heavy machines, electronic consoles, miniaturized units, cabinets, missiles, slide-mounted modules, etc.

FREE!
FASTENER HANDBOOK
Send for your free copy of Southco Fastener Handbook. Gives engineering data on many fasteners. Write to Southco Division, South Chester Corporation, 232 Industrial Highway, Lester, Pa.

© 1960



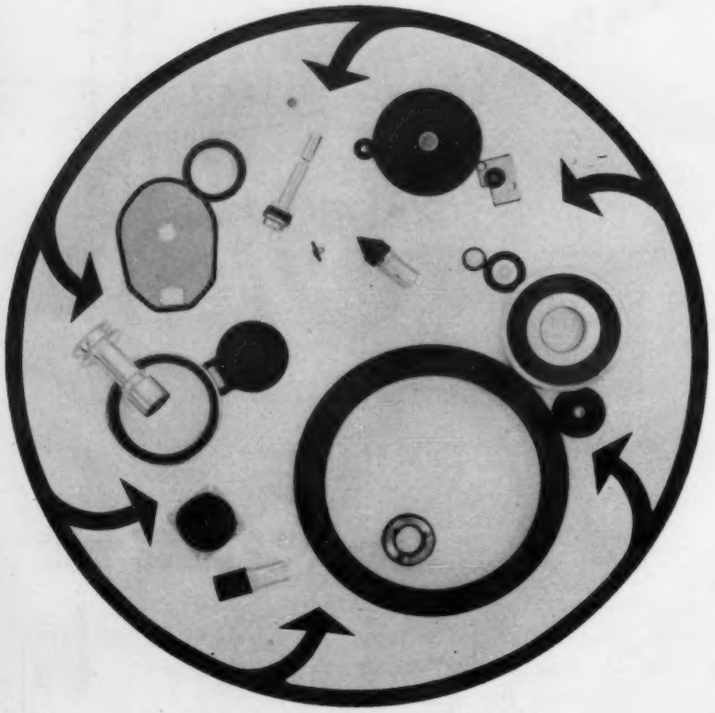
SOUTHCO FASTENERS

LION

Circle 56 on Reader-Service Card for more information

PARCO PROBLEM PROBERS

???...FAILURE-PROOF BONDING



!!! If your product design includes components where rubber is bonded to metal, how can you be sure that these bonds are failure-proof? There is no known method for testing a bonded joint except by testing to destruction. Failure-proof bonding must be accomplished during component production, not ascertained by subsequent tests. ○ This is where Parco's research, process control, scientifically designed production equipment, exacting production techniques and experienced personnel pay huge dividends in bonded joint quality and dependability. ○ Parco laboratories have thoroughly researched the bonding of rubber to metal and have developed precise and scientific process controls which assure consistent, fail-proof results. Bonding is accomplished with shop equipment *specifically designed for this specialized purpose*, and by Parco operators with years of experience in bonding. ○ Consult with Parco engineers regarding rubber-to-metal bonded joints which are stronger than the rubber itself.

Send for your latest Parco Slide Rule

Plastic and Rubber Products Company
2100 Hyde Park Boulevard
Los Angeles 47, California

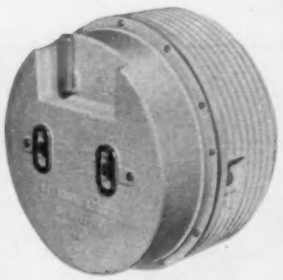
Plastic and Rubber Products Company
2100 Hyde Park Blvd. • Los Angeles 47, Calif.
Please send the Parco O-Ring Data Chart to:

NAME_____
COMPANY_____
BUSINESS ADDRESS_____
CITY_____
ZONE_____ STATE_____

Circle 57 on Reader-Service Card for more information

Electromagnetic Brake 305

A completely enclosed brake with torque ratings of 500, 750 and 1000 lb-ft operates on alternating current and is flange mounted. Benefits offered by this series are high thermal capacities and extremely low WK^2. Construction of the unit enables this series to compare favorably with more cumbersome stopping methods in regard to frequency of operation and thermal capacity. Entire operating mechanism is attached to a single plate, facilitating disassembly and assembly for maintenance.

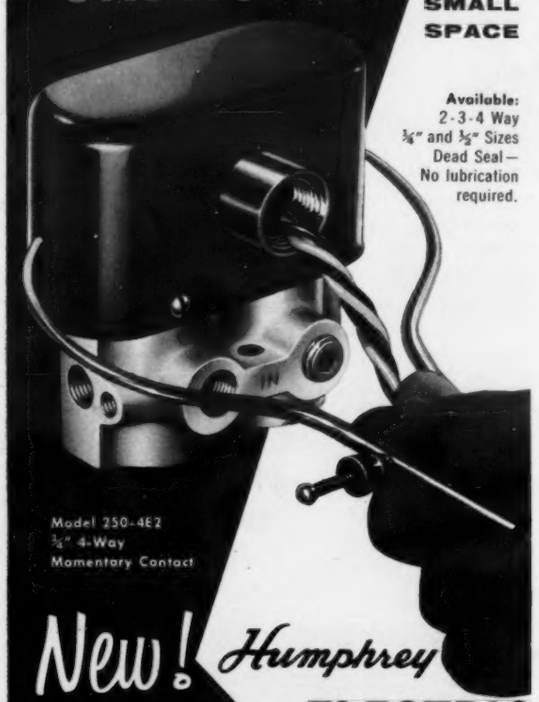


Since brake is a-c operated, control requirements are simplified, reducing cost. Need for readjustment to compensate for lining wear can be determined visually from outside enclosure. Manual release-automatic reset is included. Standard motor shaft-lengths, or through-shafts, can be accommodated. Ductile iron construction and corrosion protection make brake well suited for shipboard use. Floor-mounted models also may be obtained.

Stearns Electric Corp., 120 N. Broadway, Milwaukee 2, Wis.

DESIGN BIG VALVE CAPACITY.....INTO SMALL SPACE

Available:
2-3-4 Way
¼" and ⅜" Sizes
Dead Seal—
No lubrication
required.



Model 250-4E2
¼" 4-Way
Momentary Contact

New! *Humphrey* **ELECTRIC VALVES**

SPECIFICATIONS
(¼"-4 Way)

Pressure Range—30-125 PSI
Orifice Size—.250
Shipping Weight—3 lb. 4 oz.
Dimensions—4-5/16" x 4-1/4" x 2-3/8"
80.04 C.F.M. @ 100 PSI

EXCLUSIVE ELECTROPACT DESIGN
Coils—Epoxie Sealed, Metal Encased
Stroke (Sol.)—.022 Full

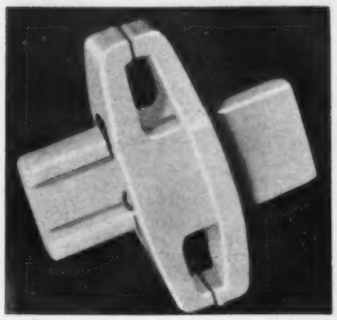
#250-4E2 Momentary Contact	#250-4E1 Maintained Contact
Voltage 115V 60 cycle	
Inrush 0.165	0.340
Hold 0.135	0.256

Other voltages available

Humphrey Products DIV.
General Gas Light Company Box 2008, Kalamazoo, Mich.

Circle 58 on Reader-Service Card for more information

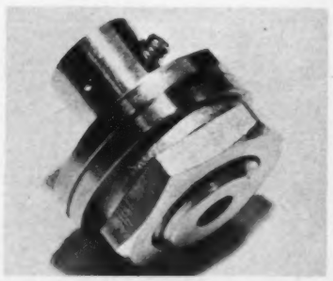
Double-Ended Clips 306



Spring-action clips open at either end with a squeeze of the fingers. Only 2 inches long, clips are made of strong lightweight plastic. Uses include holding production orders together, collating research or design notes for ready reference, displaying plans or sketches at meetings, hanging up bulletins and drying photographic prints.

Edmund Scientific Co., Barrington, N. J.

Adjustable Cam Assemblies 307



Miniature cam assemblies are useful in precision timing applications and provide positive locking at a pre-determined operational setting, within a range of 0 to 180 deg. Machined from No. 303 stainless steel, with clear passivated finish, units are stocked in 0.1248, 0.1873 and 0.2498-inch bore sizes, in pin or clamp-type hub styles.

Pic Design Corp., 477 Atlantic Ave., East Rockaway, L. I., N. Y.

Circle 59 on Reader-Service Card

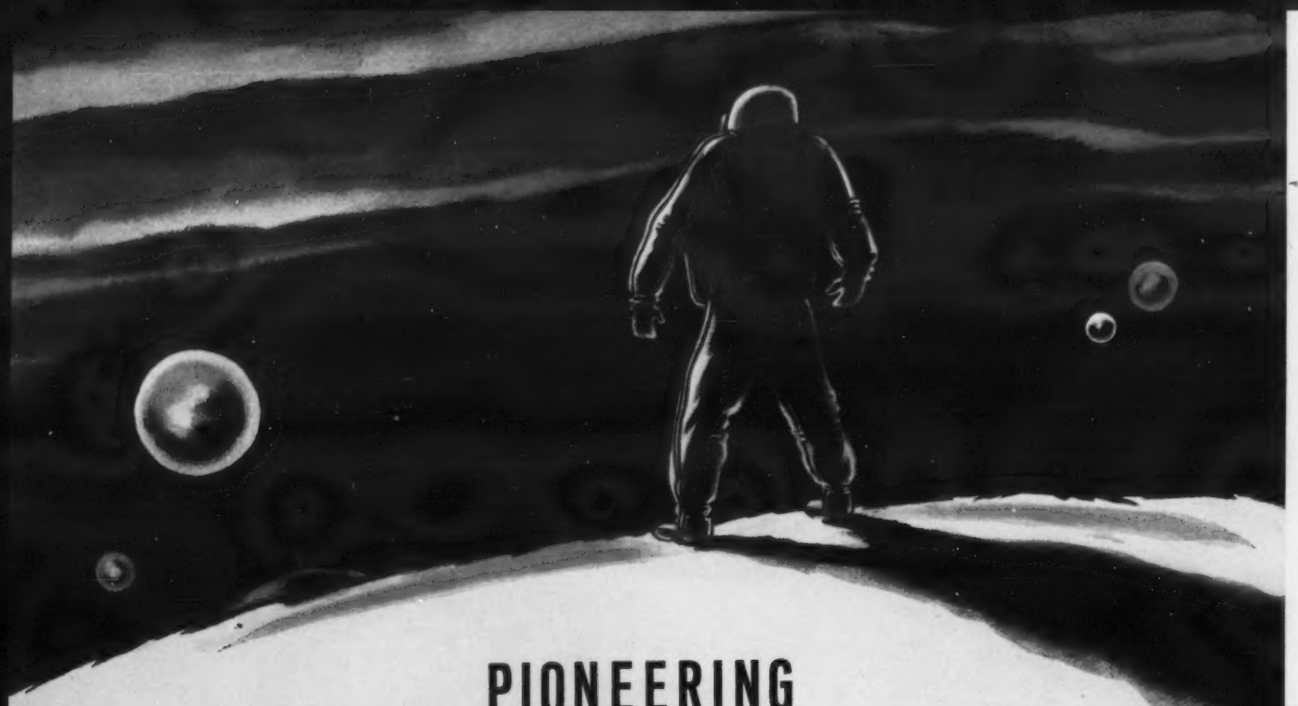
Looking for Versatility? H & H has the experience

Thirty years of experience *plus* a big stock of dies that have been accumulating over the years add up to *versatility* in the fabrication of tubular parts and *economies*, too. And if early delivery of the items you need is also important to you, this same stock of dies *plus* the techniques used in producing new ones is so great as to save you days, even weeks of waiting. It will pay you to check *today* with the man from H & H.

H•H TUBE AND MANUFACTURING CO.

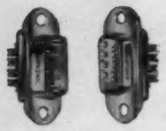
271 North Forman Avenue, Detroit 17, Michigan • Offices from Coast to Coast

PLANNED FOR PRECISION

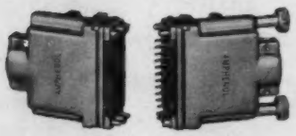


PIONEERING

A new concept in reliability—crimp Poke Home Contacts*—was pioneered and actively developed by Amphenol Connector Division. Removable contacts that are crimped outside of the body of the connector, inspected and then inserted for assembly are available in six connector lines. In Rack & Panel connectors, for example, "Poke Home" economy and reliability are offered in miniature Min Rac 17, aircraft 94 and missile 93 series.



Min Rac 17



93 Series

94 Series

In almost every application area there is an Amphenol connector with Poke Home contacts. Catalog data is available for your use.

*U.S. PATENT 2,410,010

AMPHENOL

AMPHENOL CONNECTOR DIVISION

1830 S. 54TH AVE. • CHICAGO 50, ILLINOIS

Amphenol-Borg Electronics Corporation

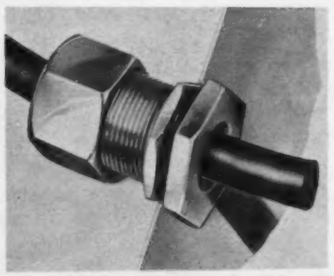
MECHANICAL

Miniature Motor 308

A 1¼-inch PM or reversible series rotary component combines motor, gear train, governor and noise filter in a single compact package. The unit provides a life expectancy of 1000 hrs without maintenance and can be governed to close tolerance of ±½ percent. This device is built to meet MIL-M-8609 (ASG) requirements for vibration, salt spray, fungus, humidity and other environmental conditions. Operating ambient temperature range is from —65 to 200F. Horsepower rating is 1/75 hp from an input voltage of 22-31v d-c, at 0.85 amps. Speed is 18,500 rpm at the rate of 26v d-c, continuous duty cycle. Components are designed to customer specification to provide exact speed and torque required.

Omega Precision, Inc., Electro-Actuators Div., 757 N. Coney Ave., Azusa, Calif.

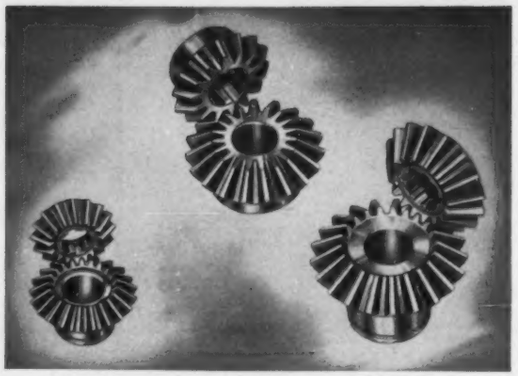
Waterproof Cable Clamp 309



This clamping device is used on electronic equipment that is exposed to water and fumes when installing a power cable or similar connection to waterproofed equipment. Clamp No. 1025 is equipped with O-rings and rubber compression grommets. The clamp is available in various sizes from stock.

Vemaline Products Co., Franklin Lakes, N. J.

Circle 60 on Reader-Service Card



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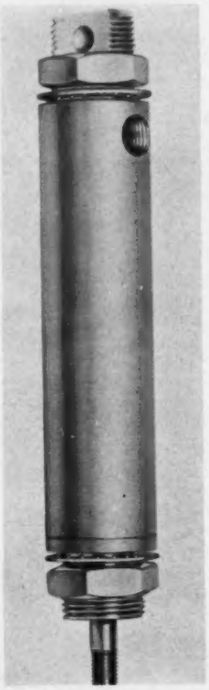
Air-Hydraulic Cylinder 310



A compact, 7/8-inch bore, 250-psi air, 2500-psi hydraulic cylinder is offered in 1-inch stroke spring return and 1, 2, 3, 5, 7 and 9-inch double-acting models. Power factor is 0.60, giving 60-lb force at 100 psi; 1500-lb force at 2500 psi. Compactness and strength are achieved through fine thread screw-together construction. All parts and seals are replaceable. Cylinders stud mount front and rear, clevis mount rear, or foot mount with nuts and lock washers. Internal cushions for long-life operation are Buna-N. Piston rods are high-carbon steel, hard chrome plated, ground and polished. Shaft extension is 1 inch, threaded 1/4-28 by 3/4 inch.

Clippard Instrument Laboratory, Inc., 7390-P Colerain Rd., Cincinnati 39, Ohio.

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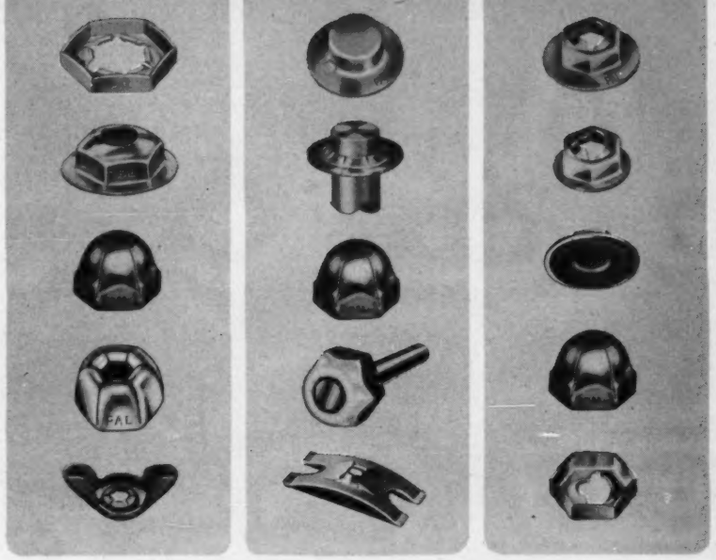

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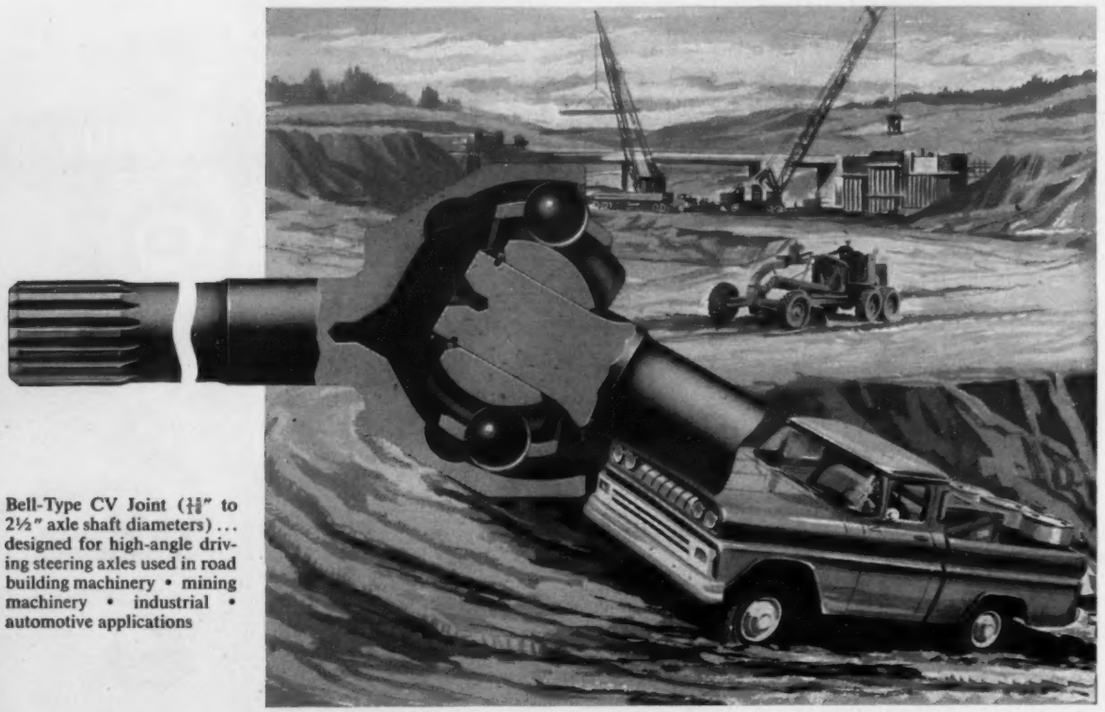
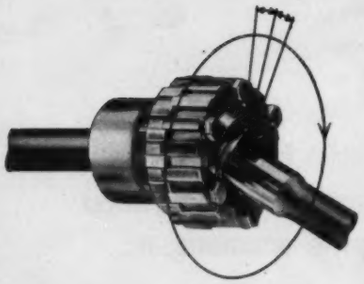
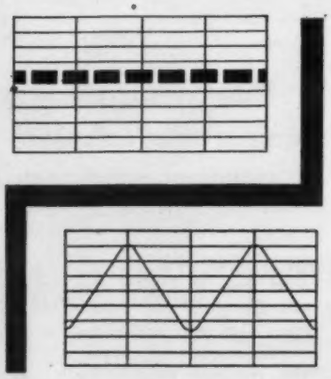
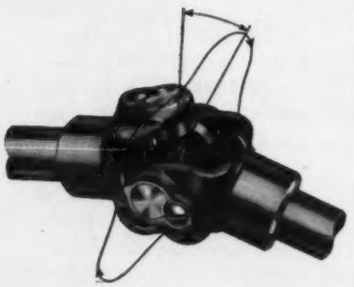


Bell-Type CV Joint (⅜" to 2½" axle shaft diameters) . . . designed for high-angle driving steering axles used in road building machinery • mining machinery • industrial • automotive applications



Disc-Type CV Joint (from 2⅛" to 16¼" swing diameter) . . . designed for all types of industrial drive applications. Rzeppa Joints always transmit torque smoothly, even at unbalanced angles. Note constant-velocity of 100% for Rzeppa Joint.





During rotation at a given angle, pin or slipper-type joints speed up, slow down twice during one revolution, as shown by the solid line in the graph.

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Detroit 11, Michigan

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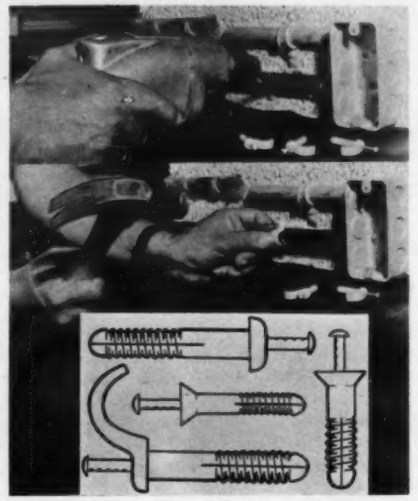
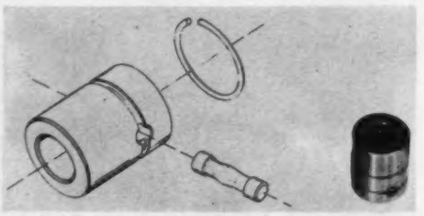
Nylon Cable Anchors 311



Cable or conduit may be mounted to walls or ceiling with JIF nylon anchors. Top picture shows drilling of concrete to receive anchor. Lower picture shows tapping in anchor, which comes complete with rust-proof nail. Regular anchors (flathead or roundhead) are used for easy mounting of mirrors, wall brackets and other decorations. Inset illustrates variety of styles and sizes.

Jordan Industries, Inc., 3030 N. W. 75th St., Miami 47, Fla.

Reamer Bushings 312



Full-floating reamer bushings correct misalignment on out-of-parallelism of turret and spindle, indexing inaccuracies and runout of hole in workpiece. Bushings enable closer tolerances to be held—only reamer floats. Manufacturer states that bushings in good floating holder will ream accurate holes under most adverse conditions.

Mueller Industries, 510 E. Rand Rd., Mt. Prospect, Ill.

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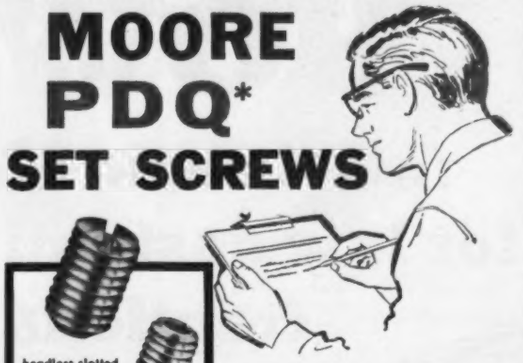

*PDQ means price, delivery, quality. And you get all three with Moore Set Screws. The PRICE is right. Ample production capacity and inventories assure fast DELIVERY. And rigid control standards guarantee there's no skimping on QUALITY. Specify Moore Set Screws and *be sure.* Dependable quality for over 80 years.

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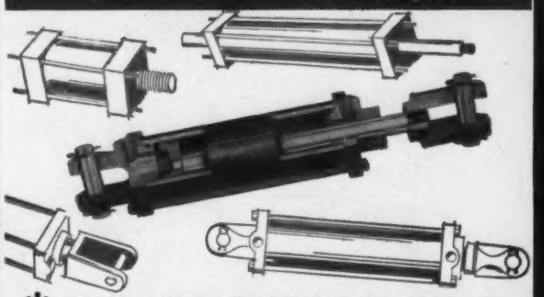

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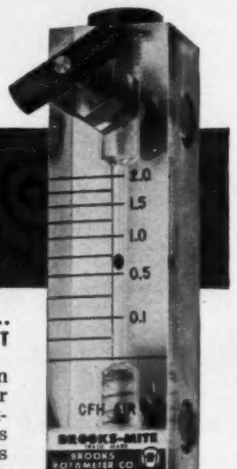

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The BROOKS-MITE has an acrylic plastic meter body and is available in 24 flow ranges. Optional features include a built-in FLO-MITE needle valve and integrally piped constant differential relay.

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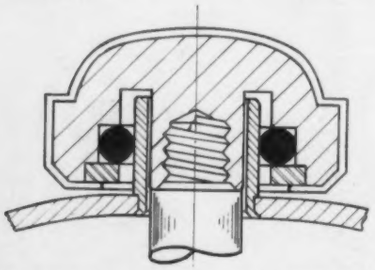
O-Ring Knob 313



This device is used as an adjusting knob on sealed precision instruments such as potentiometers, thermostats and adjustable timers. The knob seals tubes with an OD as low as 0.080 inch and as high as 0.120 inch, providing rotating freedom, high rotation accuracy, 100-percent waterproof protection, high elasticity and longer knob life. It is also resistant to vibration. The device can be used for either rotation or oscillation and withstands pressures up to 35 psi. Heart of adjusting control is a resilient O-ring made of special material molded (rather than blanked or cut) to close tolerances. The closely grained surface maintains contact with interior walls of knob and exterior diameter of instrument's winding tube.

Joseph Waldman & Sons, 133 Coit St., Irvington, N. J.

16,000-PSI Fittings 314

Steel line and fittings for pneumatic or hydraulic service feature leakproof metal crush seal and withstand pressures to 48,000 psi. Two sizes are available: 1-inch with a 5/8-inch dia flow passage, and 3/4-inch with a 3/8-inch dia passage. Specifications of 1-inch fittings and line are 1-inch OD by 5/8-inch ID, working pressure 13,250 psi with 40,000-psi burst. Material of steel line is 4130 seamless tubing. Fittings have a black oxide finish. The 3/4-inch units are 3/4-inch OD by 3/8-inch ID with working pressure of 16,000 psi and 48,000-psi burst. Material is 304 stainless steel 1/8 hard or 4130 carbon steel; fittings are 303 stainless steel or 1117 carbon steel cadmium plated.

Pressure Components, Inc., 3429-D Ocean View Blvd., Glendale 8, Calif.

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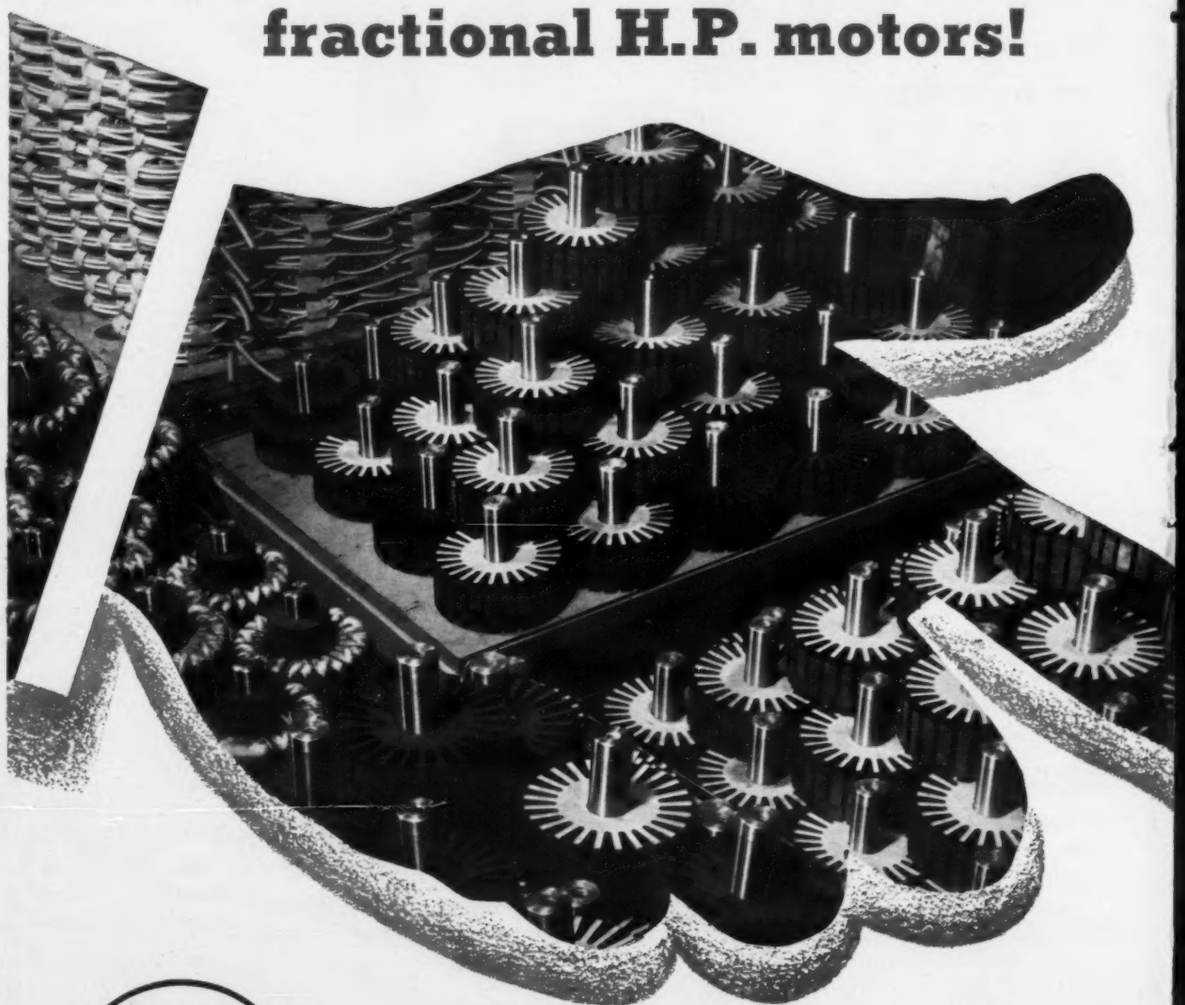

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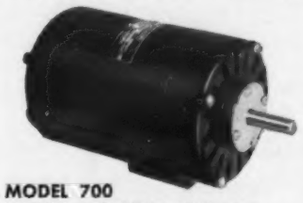
MODEL 29-500
TYPE: Universal AC/DC or Shunt.
DIAMETER: 3-5/16.
LENGTH: 4-11/16 to 5-19/32.
H.P.: Continuous: Series—1/6 @ 10,000 R.P.M.
Shunt or Compound—1/12
Intermittent Series—1/4 @ 10,000 R.P.M.
Shunt or Compound—1/6.
SPEED: No Load: Series—15,000 R.P.M.
Shunt or Compound—12,000 R.P.M.
Full Load Speed: Series—3000 to 10,000 R.P.M.
Shunt or Compound—1000 to 10,000 R.P.M.
VOLTAGES: Series—6 to 250V. AC/DC.
Shunt or Compound—6 to 230V. DC.
BEARINGS: Porous bronze sleeve type or grease sealed ball bearings.

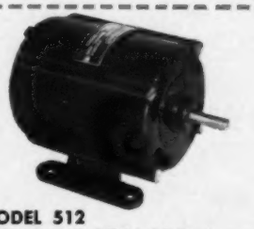


MODEL 700
TYPE: Universal AC/DC or DC Shunt.
DIAMETER: 3.800".
LENGTH: 5-7/64". to 6-7/64".
H.P.: Continuous: Series—1/4 @ 10,000 R.P.M.
Shunt—1/8.
Intermittent: Series—1/2 @ 10,000 R.P.M.
Shunt—1/4.
SPEED: No Load Speed: Series—18,000 R.P.M.
Shunt—2000 to 12,000 R.P.M.
Full Load Speed: Series—5000 to 10,000
Shunt—1000 to 10,000 R.P.M.
VOLTAGES: Series—6 to 115V. AC/DC.
Shunt—6 to 230V. DC.
BEARINGS: Grease sealed ball bearings.

MODEL 1100
TYPE: Universal AC/DC or DC Shunt.
DIAMETER: 2-13/16". LENGTH: 3-9/16".
H.P.: Continuous: Series—1/50 @ 10,000 R.P.M.
Shunt—1/50.
Intermittent: Series—1/15 @ 10,000 R.P.M.
Shunt—1/15.
SPEED: No Load: Series—15,000 R.P.M. approx.
Shunt—3500 to 12,000 R.P.M.
Full Load: Series—3000 to 10,000 R.P.M.
Shunt—2000 to 10,000 R.P.M.
VOLTAGES: Series—6 to 230V. AC/DC.
Shunt—6 to 120V. DC.
BEARINGS: Porous bronze sleeve type, or Grease Sealed Ball Bearings.

MODEL 243
TYPE: Universal AC/DC or DC Shunt.
DIAMETER: 2-17/32.
LENGTH: 3-15/16.
H.P.: Continuous Series—1/12 @ 10,000 R.P.M.
Intermittent—1/8 @ 10,000 R.P.M.
SPEED: Full Load Speed:
Series—5000 to 10,000 R.P.M.
Shunt—2000 to 7000 R.P.M.
VOLTAGES: Series—12 to 230V. AC/DC.
Shunt 6 to 120V. DC.
BEARINGS: Porous bronze self aligning type with oil reservoir.

MODEL 200
TYPE: Universal AC/DC or DC Shunt.
DIAMETER: 1-11/16".
LENGTH: 2-11/16".
H.P.: Continuous Series—1/200 @ 10,000 R.P.M.
Shunt—1/200.
Intermittent: Series—1/75 @ 10,000 R.P.M.
Shunt—1/75.
SPEED: No Load Speed: Series—15,000 R.P.M.
Shunt—15,000 R.P.M.
Full Load Speed: Series—5000 to 10,000 R.P.M.
Shunt—3000 to 10,000 R.P.M.
VOLTAGES: Series—6-115V. AC/DC.
Shunt—6 to 32V. DC.
BEARINGS: Grease sealed ball bearings.



MODEL 512
TYPE: Universal AC/DC or DC Shunt
DIAMETER: 3-3/8". LENGTH: 4-3/4".
H.P.: Continuous Series—1/10 @ 10,000 R.P.M.
Shunt—1/12.
Intermittent: Series—1/3 @ 10,000 R.P.M.
Shunt—1/6.
SPEED: No Load Speed: Series—15,000 R.P.M.
Shunt—2000 to 12,000 R.P.M.
Full Load Speed: 5000 to 10,000 R.P.M.
Shunt: 1000 to 10,000 R.P.M.
VOLTAGES: Series—6 to 230V. AC/DC.
Shunt—6 to 120V. DC.
BEARINGS: Porous bronze sleeve type.

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Shown here are just a few of the universal and dc motors in the complete, competitively priced Howard line. Our large selection of standard models, a file of over 100,000 specs and new, modern, semi-automated production facilities assure you of the motor to meet your requirements, the right price and timely delivery.

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☐ MODEL 29-500 ☐ MODEL 512 ☐ MODEL 1100

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☐ HAVE A HOWARD REPRESENTATIVE CALL ON ME

NAME_____
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COMPANY_____
ADDRESS_____
CITY_____ STATE_____

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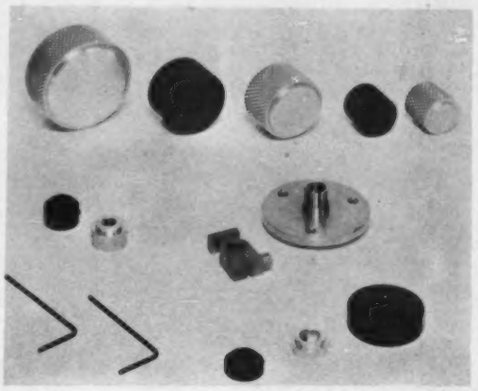
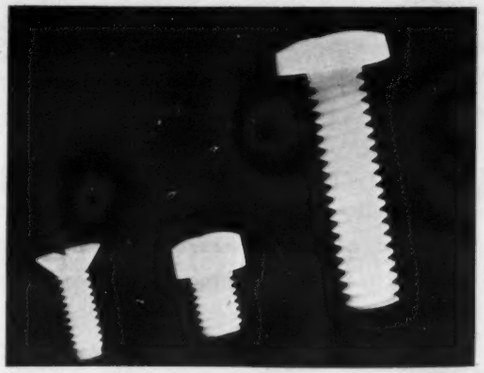
Precision Aluminum Knobs 315



Manufactured of 24 ST aluminum and supplied with polished surface or black enamel finish, precision knobs and hubs offer a concentricity of 0.0015 T.I.R. between shaft hole and step diameter. Furnished with two stainless-steel set screws, knobs are also available with "No-Burr" set screws for maintaining finish of synchro, potentiometer and other precision shafts.

Ackerman Engravers, 458 Broadway, New York, N. Y.

Acetal Resin Fasteners 316



"Delrin" offers many strength characteristics approaching those of metals. Fasteners have high electrical insulation properties, unusually high tensile strength, resistance to deformation and high dimensional stability over a wide range of environmental conditions. Creep resistance is high, particularly above 150F. "Delrin" fasteners offer low water absorption and low coefficient of friction. Another important property is their resistance to corrosive fluids such as gasoline and oils. Screws are available in a wide selection of head types, threads and lengths.

Gries Reproducer Corp., New Rochelle, N. Y.

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In all metals, in all weaves ... woven to the highest accuracy standard in the industry. You just can't buy a better wire cloth than "NEWARK." Hundreds of meshes, weaves and metals to fit *your* specific need. Years of processing experience to help you pick the right wire cloth for *your* application. Write for Bulletin FC or write us about your problem. Fast deliveries, best cloth, lowest cost when you call on NEWARK.

NEWARK for ACCURACY

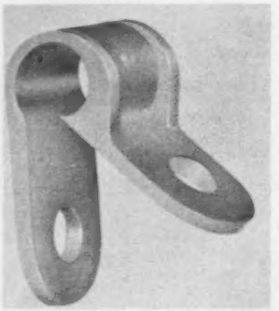
Newark Wire Cloth COMPANY

351 VERONA AVENUE • NEWARK 4, N. J.

Circle 71 on Reader-Service Card for more information

Nylon Clamp 317

Hydraulic lines or electrical wiring harnesses requiring a lightweight fastening method are a design application of the "Clamp-Tite" nylon clamp. This device, with sizes ranging from ⅛ to 1¼ inches in diameter, withstands vibration, pinching of wires or bending at any point. Molded wedge of clamp prevents entrapment or pinching of wires in harness bundles and provides a round diameter for retaining



wires or conduit, avoiding slippage and vibration. Reinforcing ribs prevent bowing or weakening of clamps at any point. Unit is impervious to nearly all corrosive liquids and fuels, is self-extinguishing, and will not deteriorate in salt air. As much as 65 percent in weight savings is accomplished over conventional metal and rubber-type clamps. Free samples, specifications and other information may be obtained.

Olympic Plastics Co., Inc., 3471 S. LaCienega Blvd., Los Angeles 16, Calif.

NEW

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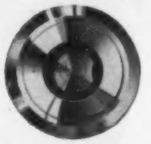
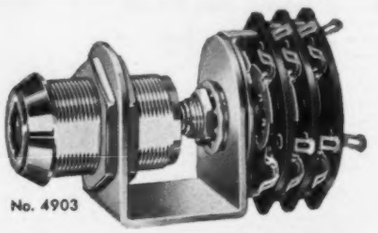


CHICAGO ACE®
PIN TUMBLER LOCKS



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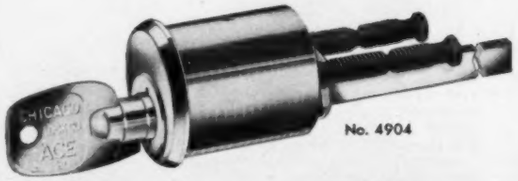

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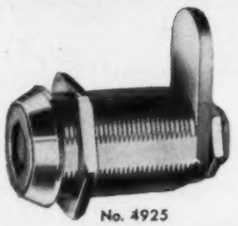
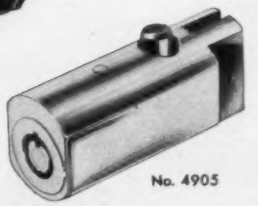


No. 4925

Hardened Steel ACE Key



No. 4905

Here is the only line of locks listed by Underwriters' Laboratories. The unique ACE Locks provide the maximum in mechanical security. Over 80,000 keying combinations are possible so that you may have your own factory-registered tumbler set-up. For technical details on models available for various applications, write for Switch Lock Bulletin UB 501.

CHICAGO LOCK CO.

2038 N. Racine Avenue • Chicago 14, Illinois

Circle 72 on Reader-Service Card for more information

Battery-Powered Motor 318

A 9v battery-powered motor offers good control with less than 2-percent variation in speed and low power consumption rating. Lightweight and small enough to fit in the palm of a hand, the precision-built unit is primarily designed for applications requiring exacting speeds and a minimum noise level. A critical and delicate component of the motor is its governor-regulator with a torque measured at a constant 1500 rpm. Variations of 600 to 700 rpm centered on 1500 rpm can be made with a simple screw adjustment. For applications requiring speeds in excess of 1500 rpm, governor unit can be removed to obtain an rpm rating up to 4000. The rotor-governor unit is dynamically balanced to provide smooth, vibration-free performance. Low power consumption of only 25 ma in a neutral position prolongs life of battery and reduces replacement costs.

Jonard International, Inc., 624 Madison Ave., New York, N. Y.

Low-Cost Machine Mounts 319

Designated Series LR 500, machine mounts can be supplied with either 3 or 4-inch leveling bolts, and with any of 3 types of material for different load ranges. This selection will accommodate almost any piece of machinery weighing up to 1000 lb, but mounts are recommended for lathes, grinders and other precision machine tools. Units eliminate need for bolting or lagging equipment to floor. Pads used in mounts provide good dampening of sound and vibration, making it possible to install machinery adjacent to quiet areas and preventing up to 85 percent of transmitted vibration from reaching floor and building structure.

Felters Co., Unisorb Div., 210 South St., Boston, Mass.

Circle 73 on Reader-Service Card

One Lamb FHP motor...up to 100,000 carbon copies mass-produced to exacting specifications

From a prototype . . . hundreds OR thousands of motors with absolute uniformity. Each and every motor produced has the same, discriminating, "built-in" perfection that you can expect with Lamb® manufacturing. This precise mechanical and dimensional uniformity of motor as an integral component for your powered product is extremely important . . . and Lamb makes sure you get it!

If you have a special motor problem . . . here's what you can expect from Lamb! *Into the design* of a Lamb motor goes years of experience in powering components for aircraft, domestic and industrial products. *Out of the design* comes a personalized motor that's dependable, smooth and efficient.

Cost-wise you're way ahead, because Lamb Motors are mass-produced at the most favorable cost.

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Series 1000, Series 3000 and Series 3100 Industrial Retaining Ring prices—in quantities up to 100,000—have been greatly reduced.

Thanks to modern, efficient production methods you can now get these Industrial Retaining Rings—either pre-stacked or bulk packed—at new, low prices . . . and pay less for pre-stacked rings than you have been paying for bulk packed. Reductions apply to standard materials and finishes.

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IRR *Originators of modern retaining ring dispensing*

INDUSTRIAL RETAINING RING COMPANY

57 Cordier Street, Irvington 11, New Jersey

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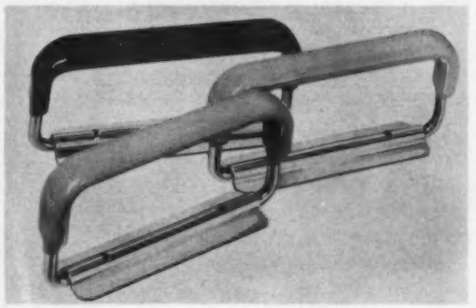
MECHANICAL

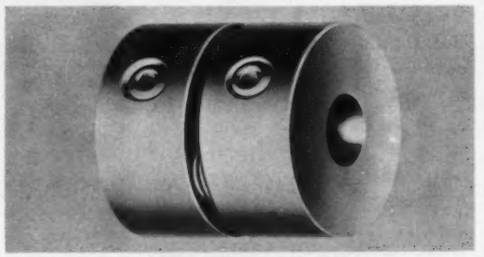
Vinyl Grip Aluminum Handles 331



Gray or black aluminum handles with vinyl dip finish are available in handle keeper with either mounting holes for rivets or blank for spot welding. An attaching tool also is offered that permits keeper to be installed without handle. This allows the designer to paint and bake equipment, then attach handle with custom tool. Cost of masking handle before painting is eliminated and normal "paint-bake" process is allowed without discoloration to vinyl material.

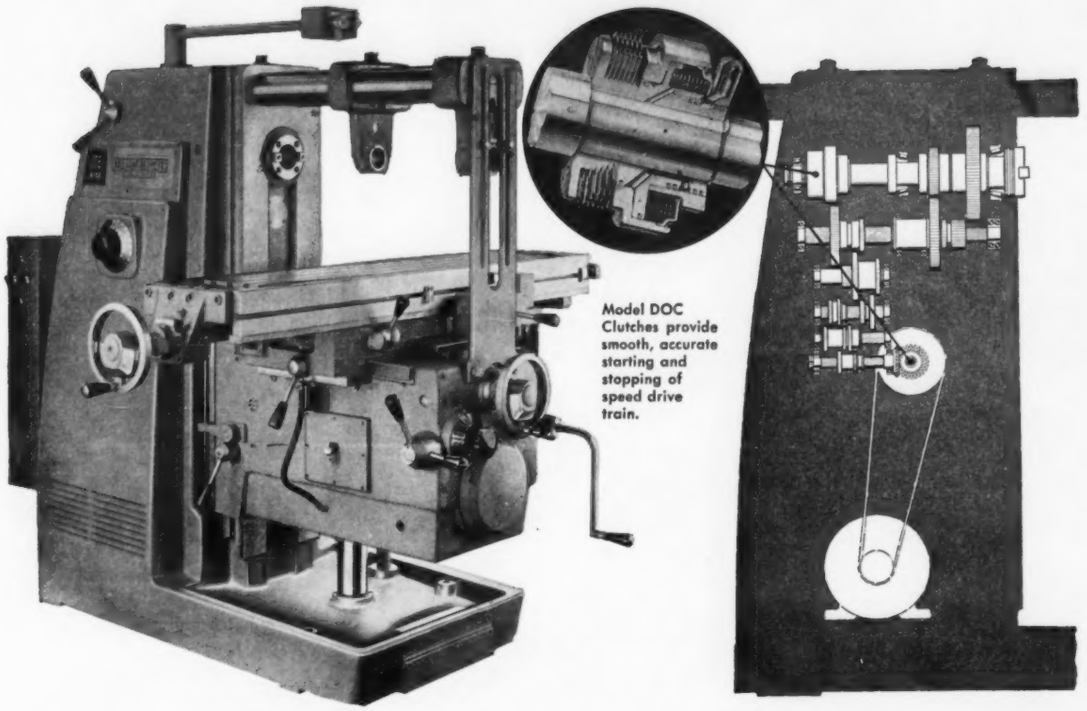
TA Mfg. Corp., 4607 Alger St., Los Angeles 39, Calif.

Miniature Overload Coupling 332



Light-duty electromechanical installations are design applications of miniature couplings with overload protection advantages. The zero-backlash unit employs torsion spring element between coupling hubs to cushion starting and braking loads. In addition, torsion spring design permits shaft-to-shaft misalignment of 5-deg angular offset and 1/32-inch parallel offset. Unit is available in aluminum, brass or stainless steel with a range of bore sizes to ¼-inch dia. Overall dimensions are ½ inch long by ⅝ inch dia.

Fourdee, Inc., P. O. Box 6006, Orlando, Fla.



Model DOC Clutches provide smooth, accurate starting and stopping of speed drive train.

In Kearney & Trecker Milling Machine . . .

Twin Disc Oil-Actuated Clutches

help make spindle drive a model of compact efficiency

There's no "gingerbread" on Kearney & Trecker's model 205 S-12 Milling Machine; unessentials have been ruthlessly purged. But the observant eye can see skillful, meticulous engineering in the smallest detail of this unit. Everything is geared to functionalism —to the objectives of simplicity, efficiency and ease of operation.

The 205 S-12 offers a wide range of speeds for virtually all metal removal jobs—20 to 1600 rpm range with 24 changes at 5 hp. With the many attachments available, this knee-type machine can do just about everything but sign the operator's paycheck.

Especially impressive in the 205 S-12 design is the speed drive train. It's amazingly compact, yet sturdy and quiet-running. Because positive starting and fast braking from high speeds call for high-energy clutches, Kearney & Trecker chose two Twin Disc DOC Oil-Actuated Clutches to handle these functions.

The ability to absorb high-energy loads makes the multiple-plate DOC Clutch unique. In addition to providing a high friction coefficient, the sintered metallic facing on the clutch plates prevent "welding" with consequent scoring. And oil actuation assures high clamping force with no wear adjustments necessary.

These features make for remarkably compact size in relation to capacity. The clutches used in the 205 S-12 machine, for example, are only 5" in diameter.

Model DOC Clutches transmit up to 137 hp and up to 690 lb-ft of torque. Twin Disc engineers can show you how these oil-actuated clutches can be profitably applied to your machines. Literature on request. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin. *Hydraulic Division,* Rockford, Illinois.

TWIN DISC

TWIN DISC

Friction Clutches and Fluid Drives

Circle 75 on Reader-Service Card for more information

New Cars and Trucks Use More Malleable For Better Performance...Lower Cost

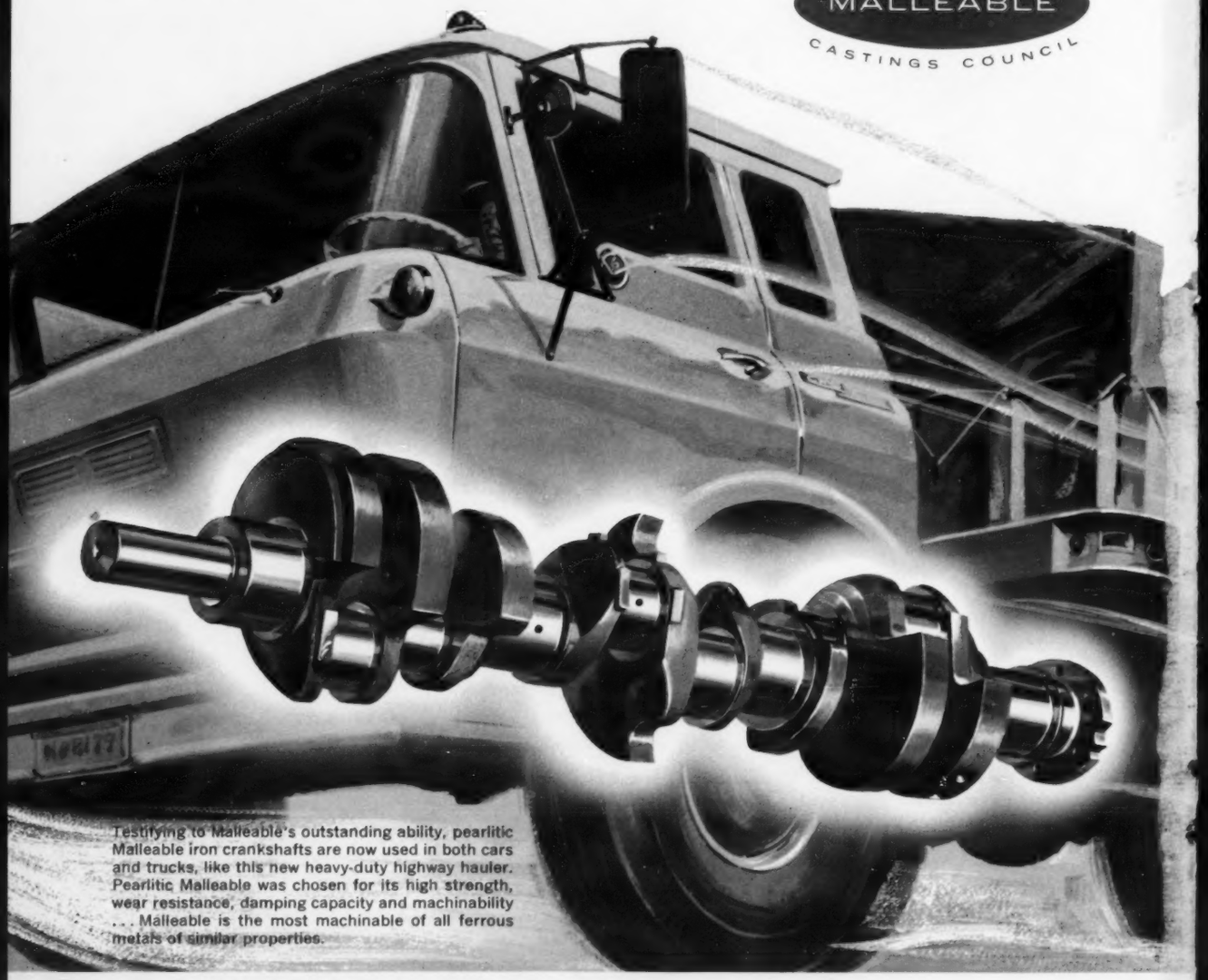
As the automotive industry steps up its drive to pack greater performance into lighter weight vehicles and still hold costs in line, the demand for Malleable iron castings continues to increase. Noted for their strength, toughness, machinability and economy, Malleables are used as key components in every make and type of vehicle.

Matching each new advance in automotive technology, Malleable is now available in a broad range of properties, including tensile strengths from 50,000 to 120,000 psi!

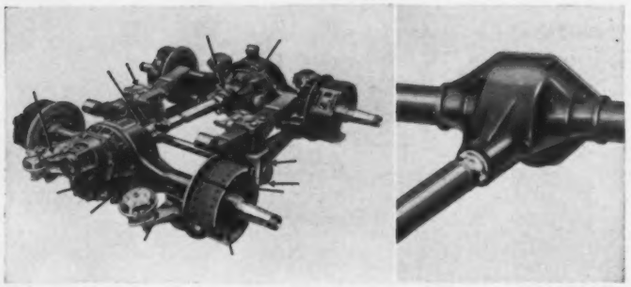
Find out now how much Malleable castings can improve your products. Contact any company that displays this symbol —

For Free Literature on advantages of Malleable iron castings, with examples from the automotive industry, ask any member company for Data Unit No. 113, or write to Malleable Castings Council, Union Commerce Building, Cleveland 14, Ohio.

MEMBER
MALLEABLE
CASTINGS COUNCIL



Testifying to Malleable's outstanding ability, pearlitic Malleable iron crankshafts are now used in both cars and trucks, like this new heavy-duty highway hauler. Pearlitic Malleable was chosen for its high strength, wear resistance, damping capacity and machinability . . . Malleable is the most machinable of all ferrous metals of similar properties.



From the smallest cars to the largest trucks, all American vehicles rely on Malleable for a range of uses. In this tandem axle, for example, a total of 36 parts is Malleable.

Malleable differential carriers form the backbone of the rear axles on many new compact cars, as shown at the right above. Tubular steel extensions are pressed into the Malleable housing where they are "puddle" welded. Decisive factors in Malleable's selection were strength, economy, ease of machining and ability to be produced in a design that required a minimum of tooling expense.

The increasing conversion from other materials to Malleable castings for all kinds of parts from crankshafts to door hinges is adding momentum to the automotive industry's steadily increasing use of Malleable.

Among the many Malleable iron castings in this composite car are torsion bar arms and brackets, rocker arms, fan pulleys, sprockets, emergency brake drums, pedals and spiders, steering gear housings, universal joint yokes, bearing caps, transmission gears, shifter forks, turbine hubs and a variety of brackets, housings and cases.

For Quality and Economy Use

MALLEABLE

For Service Contact...

CONNECTICUT
Connecticut Mall. Castings Co., New Haven 6
Eastern Malleable Iron Co., Naugatuck

DELAWARE
Eastern Malleable Iron Co., Wilmington 99

ILLINOIS
Central Fdry. Div., Gen. Motors, Danville
Chicago Malleable Castings Co., Chicago 43
Moline Iron Works, Moline
Moline Malleable Iron Co., St. Charles
National Mall. and Steel Castings Co., Cicero 50
Peoria Malleable Castings Co., Peoria 1
Wagner Castings Company, Decatur

INDIANA
Albion Malleable Iron Company, Muncie Division, Muncie
Link-Belt Company, Indianapolis 6
National Mall. & Steel Castings Co., Indianapolis 22

IOWA
Iowa Malleable Iron Co., Fairfield

MASSACHUSETTS
Belcher Malleable Iron Co., Easton

MICHIGAN
Albion Malleable Iron Co., Albion
Auto Specialties Mfg. Co., Saint Joseph
Cadillac Malleable Iron Co., Cadillac
Central Fdry. Div., Gen. Motors, Saginaw

MINNESOTA
Northern Malleable Iron Co., St. Paul 6

MISSISSIPPI
Mississippi Malleable Iron Co., Meridian

NEW HAMPSHIRE
Laconia Malleable Iron Co., Laconia

NEW YORK
Acme Steel & Mall. Iron Works, Buffalo 7
Frazer & Jones Company Division Eastern Malleable Iron Co., Solvay
Oriskany Malleable Iron Co., Inc., Oriskany
Westmoreland Mall. Iron Co., Westmoreland

OHIO
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Central Fdry. Div., Gen. Motors, Defiance
Dayton Mall. Iron Co., Ironton Div. Ironton
Dayton Mall. Iron Co., Ohio Mall. Div., Columbus 16
National Mall. and Steel Castings Co., Cleveland 6

PENNSYLVANIA
Buck Iron Company, Inc., Philadelphia 22
Erie Malleable Iron Co., Erie
Lancaster Malleable Castings Co., Lancaster
Lehigh Foundries Company, Easton
Meadville Malleable Iron Co., Meadville
Pennsylvania Malleable Iron Corp., Lancaster

TEXAS
Texas Foundries, Inc., Lufkin

WEST VIRGINIA
West Virginia Mall. Iron Co., Point Pleasant

WISCONSIN
Belle City Malleable Iron Co., Racine
Chain Belt Company, Milwaukee 1
Federal Malleable Company, Inc., West Allis 14
Kirsh Foundry Inc., Beaver Dam
Lakeside Malleable Castings Co., Racine
Milwaukee Malleable & Grey Iron Works, Milwaukee 46

These companies are members of the Malleable Castings Council

Plunger-Type Fastener 333

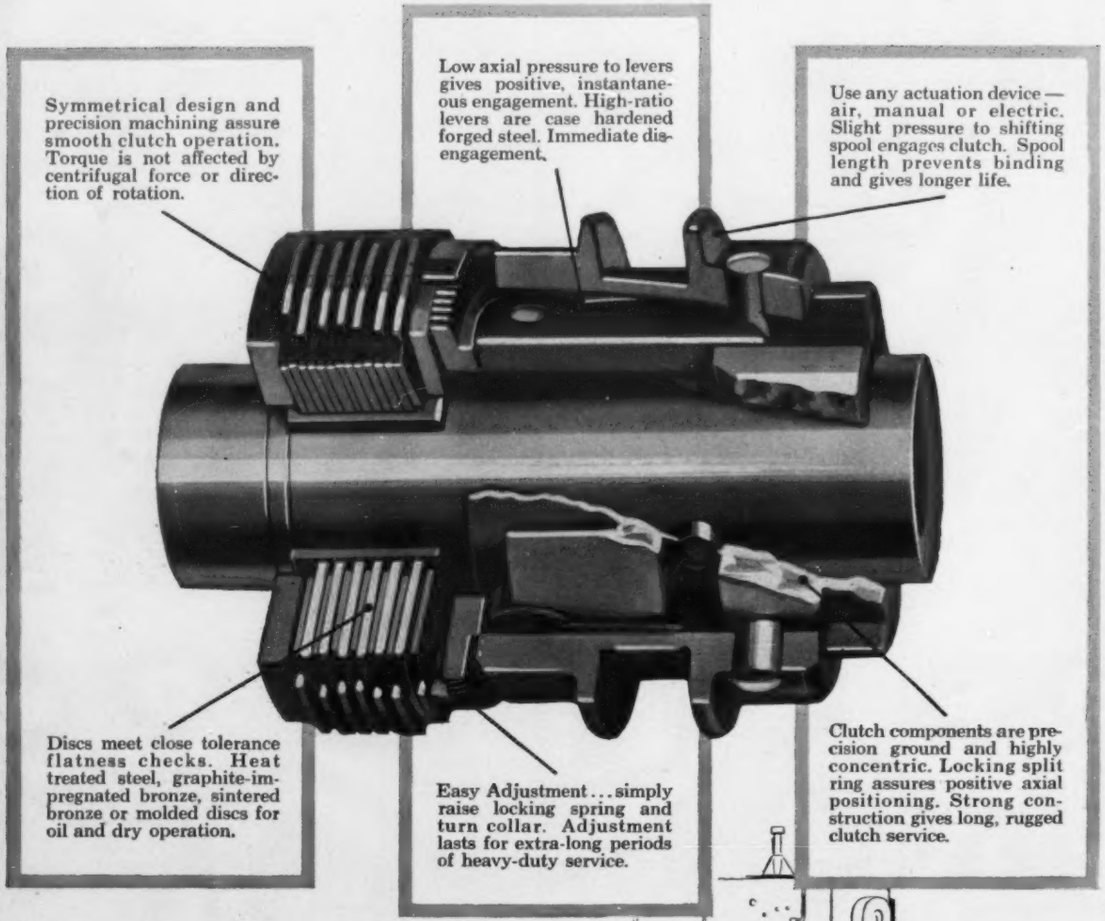
Composed of two parts, the "Nylatch" features a molded grommet and a metal plunger, both of which remain captive in the removable panel or door. Providing an easy fastening and unfastening unit, the plunger-type fastener is inserted through a hole in the fixed section. Pressing plunger forces grommet fingers to expand on inside of hole to a greater diameter than hole itself. Reaction of plunger collapses fingers, permitting assembly to be withdrawn. Only two holes with standard tolerances are required for installation. One single-size assembly will accommodate a range of thicknesses to be fastened.

Hartwell Co., 9036 Venice Blvd., Los Angeles 34, Calif.

Gear Train Servo 334

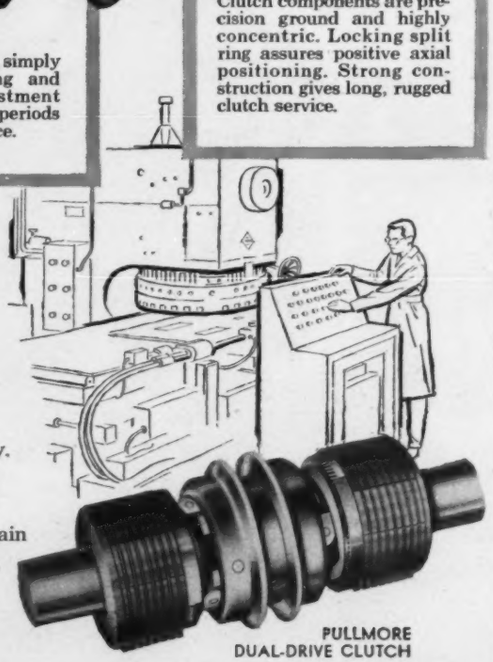
One miniature servo package accommodates gear ratios up to 1000:1 and two size 8 rotary components to suit application. This package is 1.00 inch wide by 1.812 inches long and weighs 4 to 6 oz, depending upon materials and components. Other units accommodate gear ratios up to 4000:1 and a choice of two size 8 rotary components. A package such as this is 1.280 inches wide by 1.90 inches long and weighs 6 to 12 oz, depending upon materials and components. Fine pitch precision gears used in each unit are mounted between jig-bored gear plates and completely enclosed to insure long life under varying environmental conditions.

Clifton Precision Products Co., Inc., 5050 State Rd., Drexel Hill, Pa.


Symmetrical design and precision machining assure smooth clutch operation. Torque is not affected by centrifugal force or direction of rotation.
Low axial pressure to levers gives positive, instantaneous engagement. High-ratio levers are case hardened forged steel. Immediate disengagement.
Use any actuation device — air, manual or electric. Slight pressure to shifting spool engages clutch. Spool length prevents binding and gives longer life.
Discs meet close tolerance flatness checks. Heat treated steel, graphite-impregnated bronze, sintered bronze or molded discs for oil and dry operation.
Easy Adjustment ... simply raise locking spring and turn collar. Adjustment lasts for extra-long periods of heavy-duty service.
Clutch components are precision ground and highly concentric. Locking split ring assures positive axial positioning. Strong construction gives long, rugged clutch service.

Increase production with Pullmore Clutches

Modern, high-production machines depend on efficient clutch controls. Today's clutches must be versatile, must provide fast but smooth actuation, must transmit full power and must be designed for enduring controllability. Rockford Pullmore Clutches meet these requirements. They start, stop, reverse, shift, inch, cycle and idle. Pullmore dual-drive clutches drive forward and reverse, obtain high and low speeds, or control as clutch-brake combinations. Engagement is fast, smooth and positive. The high torque, compact clutches handle loads from 126 to 11,000 inch lbs. Write for illustrated brochure.



PULLMORE DUAL-DRIVE CLUTCH

ROCKFORD CLUTCH DIVISION OF BORG-WARNER

321 CATHERINE STREET, ROCKFORD, ILLINOIS

Export Sales Borg-Warner International • 36 So. Wabash, Chicago, Ill.

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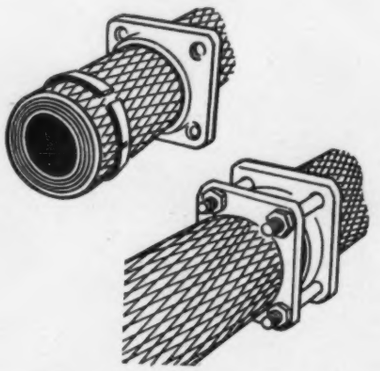
MECHANICAL

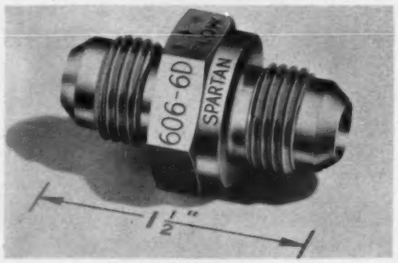
Pipe Lockring Assembly 335



A serrated locking ring, used with matching flanges, is the key to fast, simple procedure for on-site installation of armored impervious graphite pipe, without use of adhesive or threading. Pipe is joined together at the same time that flanges are attached. This method results in speed and ease of assembly and consequently in lower cost of installation (the manufacturer claims). In addition, the assembly permits practical re-use of pipe and fittings if requirements change.

Falls Industries, Inc., Solon, Ohio.

Miniature Check Valve 336



Available in tube sizes from ¼ to 1¼ inches, this check valve is qualified for military use to specification MIL-V-7899. Identified as the Spartan 606, it has a maximum cracking pressure of 8 inches of H_2O while total pressure drop does not exceed 20 inches of H_2O at rated flow. Designed for aircraft fuel systems and other applications where operating pressures do not exceed 60 psi, valve is compatible with 90 percent hydrogen peroxide, nitric acids and other fuels.

Spartan Mfg. Corp., 445 Saw Mill River Rd., Yonkers, N. Y.

NEED SPECIAL PULLEYS?

NAGEL-CHASE CAN HELP!

When you need FHP V-Belt Pulleys of special design, you can do better by consulting Nagel-Chase. This company has specialized in FHP pressed steel V-Belt pulleys for more than a quarter century.

The step-down pulley illustrated is a typical example of many especially designed pulleys Nagel-Chase has engineered for use on compressors, washers, dryers, lawn mowers, tractors and agricultural equipment.

Whenever there's a V-Belt Pulley on your new model or product, be sure to consult Nagel-Chase.

Write for Catalog

Special low cost step down pulley designed and produced in quantity by Nagel-Chase Stamped metal hub with built-in oil reservoir replaces usual solid metal hub.

The NAGEL-CHASE MFG. CO. 2819 No. Ashland Ave. Chicago 13, Ill.

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BIG BRONZE PLATE!

Ampco Metal sheet and plate are available in varying dimensions and up to 10,000 lbs. Examples: A single ½" plate can be big enough to form a tank 16' long x 11'-6" diameter. A tube sheet 3" thick can be rolled 9'-0" in diameter. Discuss your requirements for corrosion, abrasion, or mechanical service with your Ampco field engineer. Call him in soon.

AMPCO®

Write for Bulletin PI-5

AMPCO METAL, INC.
Dept. 40C, Milwaukee 46, Wisconsin
West Coast plant: Huntington Park, California
Southwest plant: Garland (Dallas County), Texas G-28

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OHIO WELD NUTS

RH NUT
Thread Size 6-32 to ⅜-16

WF NUT
Thread Size 6-32 to ⅜-16

SF NUT
Thread Size ½-13

WW NUT
Thread Size 6-32 to ⅜-16

OHIO flanged weld nuts provide extra-long thread engagement and are ideal for assemblies requiring strong primary fasteners. They can also serve as spacers or bearing surfaces where required.

Samples and information furnished upon request.

The OHIO WELD FASTENERS Primary Fastener in Fastener Assemblies

THE OHIO NUT AND BOLT CO.
29 FIRST STREET BEREA, OHIO

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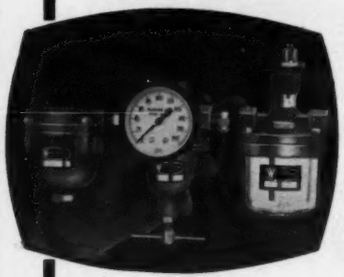
Low-cost... Wilkerson MINIATURES...



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"DIATROL" REGULATOR Large flows • 3 outlet ports • Non-chattering, self-relieving • 300 PSI maximum • 0-50, 5-125 or 10-250 PSI ranges.

"ATOMIZER" LUBRICATOR Up to 75 CFM • Site Flo Gauge and 2 fill holes • 250 PSI maximum • Starts lubricating at 1 CFM.

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The new Abart Catalog offers 92-pages of valuable information, engineering data, detailed drawings and photos. Here is a handy and accurate means of selecting the *exact* Abart Speed Reducer or Precision-Cut Gear for any application—fast, easy to use.

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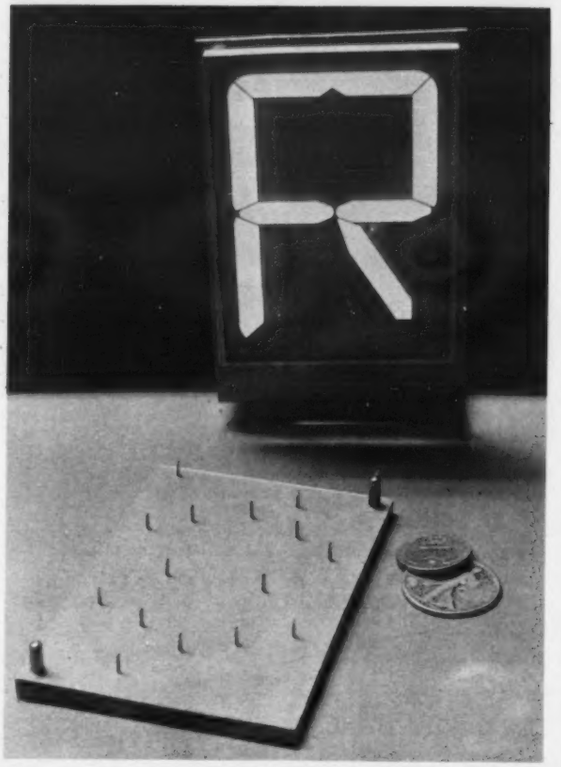
Large-Size Readout Lamps 337

Lamps made in the shape of a parallelogram have outside rectangular dimensions of 3-5/16 inches wide by 4¾ inches high. When mounted with other lamps, each lamp uses only 3⅜ inches of panel width. Peripheral measurement of the maximum size figure or number which can be displayed is 2⅝ inches wide by 4 inches high. Lamps can be read at distances up to 150 ft, depending on ambient lighting conditions. Units operate at either 240 or 460v and at 60 or 400 cycles. Lamps use only 0.01w when all segments are lighted. Switching to form various letters and numerals can be accomplished with step relays, rotary switches, solid state or electromechanical devices, or by other means. Response time to voltage applied to lamp is less than one cycle; numerals and letters change faster than eye can see. Lamps, designated style RA-4000, are available for immediate delivery.

Westinghouse Electric Corp., Lamp Div., MacArthur Ave., Bloomfield, N. J.



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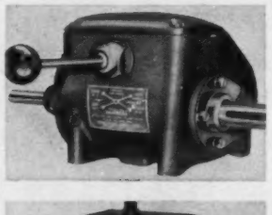
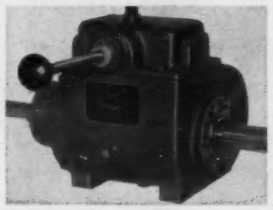
TRANSMISSIONS *featuring* Electro-Magnetic Control





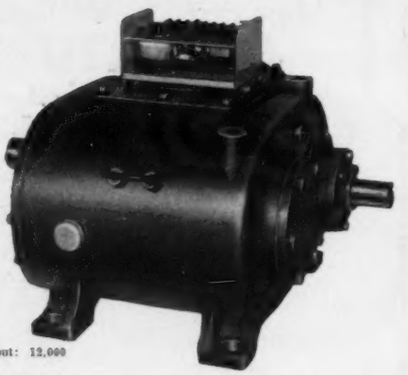
9000-B (1-10 H. P.)
TORQUE RATING: 1400 pound inches output, 350 pound inches input
HORSEPOWER RATING: 5 H.P., 900 r.p.m. input; 10 H.P., 1800 r.p.m. input
GEAR RATIOS: 1:1—2:1—3.14:1—4:1 Special ratios at extra cost. Maximum Reduction 5.07:1

8100-B (10-20 H. P.)
TORQUE RATING: 700 pound inches input, 2800 pound inches output
HORSEPOWER RATING: 10 H.P., 900 r.p.m. input; 20 H.P., 1800 r.p.m. input
GEAR RATIOS: 1:1—2:1—3:1—4:1 Special ratios at extra cost. Maximum Reduction 6.00:1

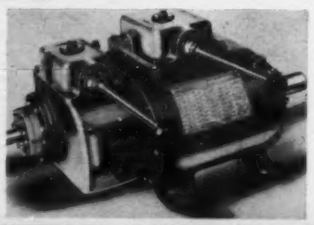
14800 (left)—Four special speed changes up to limit of case 10:1
14900 (left)—Four speed changes in geometric progression at 1.71 (total reduction of 5.03)
TORQUE RATING: 1400 pound inches input, 7500 pound inches output
HORSEPOWER RATING: 20 H.P., 900 r.p.m. input; 40 H.P., 1800 r.p.m. input

. . . for industrial and agricultural machinery, automotive trucks, tractors, refuelers, industrial shovels, cranes, shop and lift trucks, concrete mixers, road builders, diamond drills, machine tools . . .

Send for catalog and complete information



9300 (30-60 H. P.) below
TORQUE RATING: 2100 lb. in. input: 12,000 lb. in. output
H.P. RATING: 30 H.P. at 900 R.P.M. 60 H.P. at 1800 R.P.M.
Eight Speed Changes in geometric progression of 1.29 (total reduction 5:1) Special ratios at extra cost.



Transmissions with Electro-Magnetic Clutches provide speed changes and reversing under power, without interrupting power source . . . so equipped are available with two to eight speeds, capacities from 52 to 750 foot pounds and a wide ratio selection (up to 10:1). Manual or automatic controlling of speed changes accomplished with electric switches, tape, cam or other remote control means available. Especially adaptable to automatic machinery where transmission is not accessible to the operator. Model 14800-EC (above) Control Box has cover Plate removed.

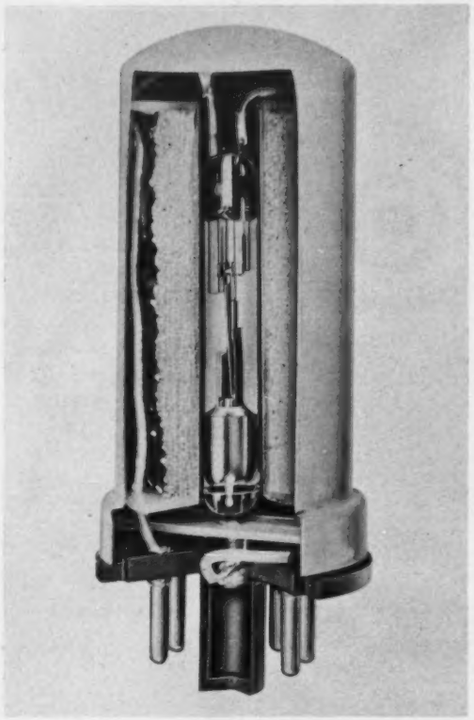
WESTERN TRANSMISSIONS
WESTERN MANUFACTURING CO. — 3400 SCOTTEN AVE. — DETROIT 10, MICHIGAN

Circle 85 on Reader-Service Card for more information

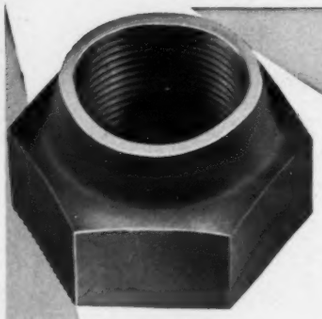
Mercury-Wetted Contact Relay 338

This mercury-wetted contact relay is designed to give over a billion reliable operations with complete freedom from contact bounce. It is adaptable to computers and data-processing equipment as well as in machine tool applications. The high-speed unit requires no maintenance and is capable of high-power or low-level operation. The device consists of a contact assembly mounted and sealed in a glass capsule, an operating coil, and a steel housing with an 8-pin octal plug. Switch capsule is enclosed by coil and is located in magnetic field set up by coil. Contact and armature assemblies are hermetically sealed in a glass capsule with a hydrogen atmosphere under high pressure. Minimum operate time of single capsule relay is 3 millisec with a coil input of approximately 2w. Release time is about 3 to 3½ millisec under all conditions of coil input power. Switch capsule can be driven at speeds up to 100 operations per second. Relay will switch 250v-amp loads with a maximum of 5 amps, 500v. It has an operating sensitivity of 250 mw minimum. Relay is 1.105 inches in diameter and 3.196 inches high.

Automatic Electric Sales Corp., Northlake, Ill.



New One-Piece
"Conelok"
with prevailing torque



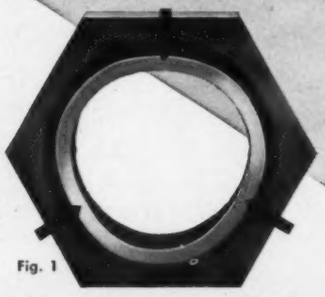


Fig. 1

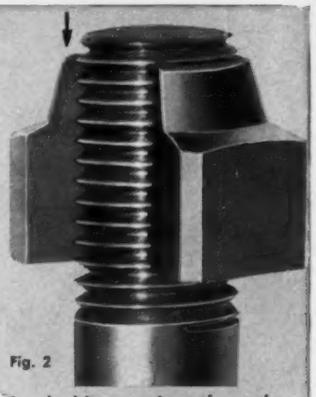


Fig. 2

Three sectors of the tapered portion of the CONELOK nut are preformed inwardly (Fig. 1). When the Nut is applied to a bolt, these conforming sectors are elastically returned to a circular configuration and create an inward and downward pressure which produces intimate contact between the load carrying flanks of the nut and bolt threads (Fig. 2). The shape of the cone sector displacement insures conformity with the mating bolt and maximum friction contact area. . . . The closed stress path in the locking portion of the nut and the advantageous distribution of locking pressure, produce a locking device of high fatigue life . . . and equivalent locking force is exerted at only a fraction of the stress of any slotted type locknut. CONELOK maintains its locking action through many re-applications. . . . It is adaptable to high, and low torque assemblies . . . to high torque stop-nut applications . . . and may be obtained in sizes from No. 10 through 1½", Full and Thick dimensions are "Standard". . .

Send for brochure which includes complete engineering specifications.

NMP

NATIONAL MACHINE PRODUCTS COMPANY
an SPS company 44250 UTICA ROAD UTICA, MICHIGAN

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From the day this plant started it has been shaped by the needs of customers like you. And so you find under one roof at Synthane your complete answer in laminated plastics—sheets, rods, tubes, molded-laminated, molded-macerated and fabricated parts. Synthane has all the facilities necessary for designing and producing tools, dies, jigs and fixtures for fabrication, a mine of information on the proper methods for machining laminated plastics. Versatility from one source. One high quality. One responsibility.

You-shaped Versatility makes Synthane a Better Buy in Laminates.

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Synthane Corporation, 6 River Rd., Oaks, Pa.

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Please send me information relating to Synthane as a source for laminated plastic materials and parts.

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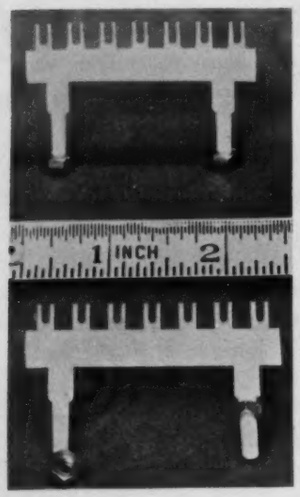
Plastic Mounting Strip 339

Polyethylene and polypropylene plastic mounting strips are available in standard or special sizes and specified materials. Units adapt to automated production methods, allow for preplanning circuit and component layout, and contribute to use of pre-assembled circuit modules or subchassis assemblies. They may be mounted quickly in prepunched holes and fastened with self-threading nuts, speed nuts or heat swaging. Dielectric constants of strips are 400 percent better than phenolic and 300 percent better than ceramic. Loss factors are 200 times better than phenolic, 30 times better than ceramic strips. Pretinned terminals accept all types of solder. Strips are made of lightweight plastic, non-breakable and chemically inert.



Electro-Glass Laboratory, 4000 S. W. 114th St., Beaverton, Ore.

Circle 88 for Reader-Service

OHIO *Round Tubing*
To 7-1/2" OD x .375" wall

A-3873A

OHIO *Square Tubing*
To 6" x 6" x .259" wall

OHIO *Rectangular Tubing*
To 7-1/2" major diameter x .259" wall
Typical 4" x 6" x .259" wall section illustrated

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OHIO QUALITY WELDED STEEL TUBING

in larger sizes...heavier wall thicknesses

OHIO SEAMLESS TUBE

Division of Copperweld Steel Company • **SHELBY, OHIO**

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New sizes and heavier wall thicknesses of Ohio Quality Welded Steel Tubing (up to 7½" OD) now parallel the sizes of famous Ohio Seamless Steel Tubing. That means — now more than ever — there's a type and size of Ohio tube to fit your special requirements exactly. And since we make both types, we're in a position to recommend the best type for your own particular needs. Ohio Tubing — either welded or seamless — is just "made to order" for your product.

Cut along line and send air mail to save time.

RUSH me, without obligation, latest information on new larger sizes and heavier wall thicknesses of Ohio Welded Steel Tubing.

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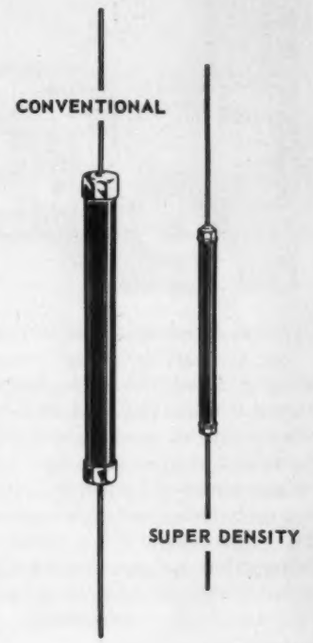
Company _____

Address_____ City_____ State_____

High-Voltage Selenium Rectifier 340

The cells used in these cartridges measure only 0.019 inch in thickness. Since the number of cells in the rectifier determines its voltage-handling capabilities, it is evident that use of these cells results in a substantially shorter component for any given voltage. Illustrative of this size reduction is this example involving a typical application: 5000v peak inverse at 1 ma d-c into a capacitive load at 40C ambient. A conventional selenium rectifier cartridge measures 3 inches long and ¼ inch in diameter. This cartridge is only 2 inches long and ⅛ inch in diameter. Encased in phenolic tubes, cartridges are provided with either pigtail-on-ferrule (axial) leads or insulated with epoxy-sealed leads. Rectifier is supplied in PIV values ranging from 50 to 20,000v and for current output requirements of 50 ma d-c.

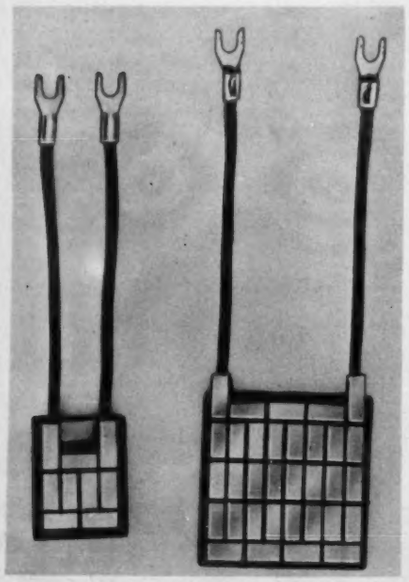
Electronic Devices, Inc., 50 Webster Ave., New Rochelle, N. Y.



Circle 88 for Reader-Service

Cooling Modules 341

The F1, F4, F8 and F32 solid-state cooling modules, designated by a number corresponding to number of thermocouples in module, are currently in quantity production. Heat-pumping capacity is of the order of 1w per couple. Thermocouples made from a new form of Neelium are now capable of producing a no-load temperature difference as high as 80C when measured with its hot junction at 27C. This makes it possible to achieve



very low temperatures for many applications, particularly when connected in thermal cascade. The series operates with currents in the region of 10 to 15 amps. Couples of all modules are electrically connected in series, each requiring in the neighborhood of 0.1 to 0.3v. Typical uses are component cooling, temperature stabilized enclosures below ambient, small refrigerators and air-conditioning equipment, fluorescent tube cooling, and scientific and medical instruments requiring reduced temperatures.

General Thermoelectric Corp., subsid. of General Devices, Inc., Princeton, N. J.

WHEN YOUR "SPECS" READ HYATT YOU GET TRIPLE VERSATILITY

USE THE HYATT IMPROVED

1 MORE FLEXIBLE ASSEMBLY

Interchangeability of Hyatt separable bearing parts permits more flexible assembly. Any HYATT Metric Radial Series separable inner race, for a given piece number, can be assembled with any HYATT outer race and roller assembly of the same piece number.

Because of this interchangeability, it is practical to install separable HYATT inner races on shafts in one location, while the outer races and rollers are installed in housings at another location. When the sub-assemblies are brought together, the bearing parts will match perfectly. There is seldom need for selective assembly.

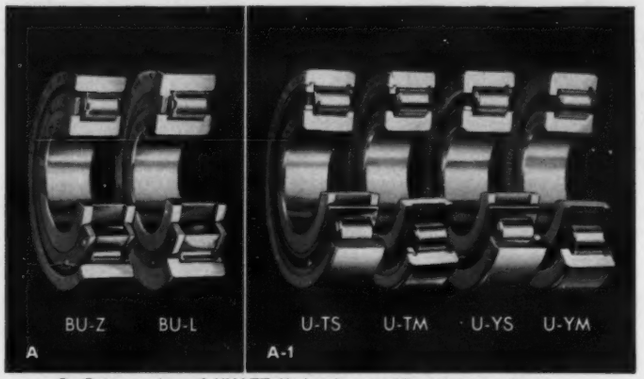
2 INCREASED SHAFT DIAMETERS

When the designer wishes to use a larger, more rigid shaft, without increasing the size of the housing bore, he utilizes another advantage of HYATT separable bearings. He can eliminate the inner race of the separable inner race HYATT bearing types and operate the bearing rollers directly on the suitably hardened and ground shaft. Space usually occupied by the inner race is available for a larger shaft.

3 REDUCED HOUSING BORE SIZES

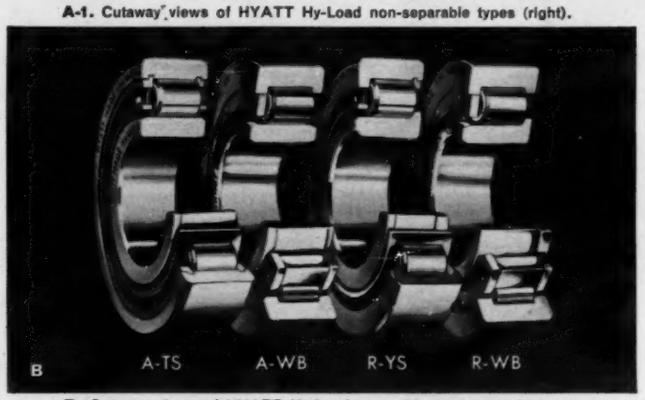
On the other hand, when space limitations force you to reduce the size of the housing bore without decreasing shaft diameter, versatile HYATT separable bearings are again the answer. This time you merely eliminate the outer race of one of the separable outer race HYATT bearing types—and operate the rollers directly on the suitably hardened and ground bore. You save the space normally occupied by the outer race.

And, of course, in applications where it is advisable to retain the complete bearing parts as a unit, HYATTS are available in non-separable assemblies.



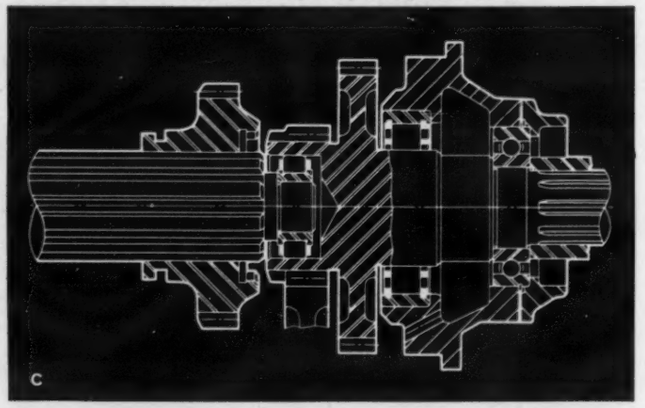
A. Cutaway view of HYATT Hy-Load separable outer race types.

A-1. Cutaway views of HYATT Hy-Load non-separable types (right).



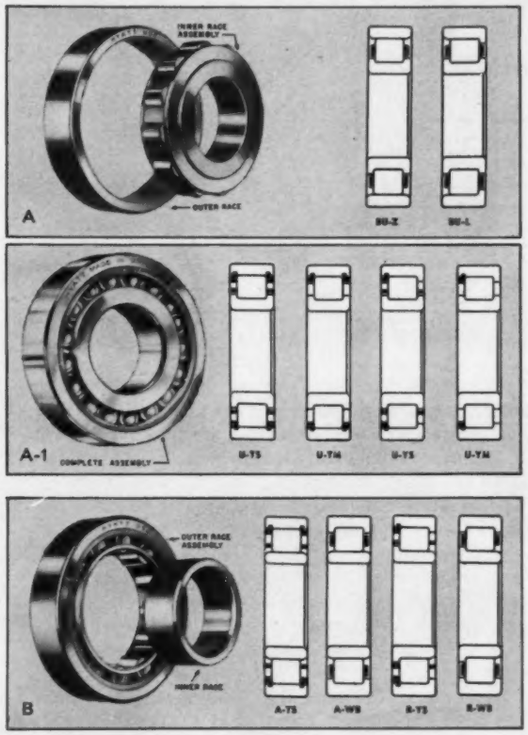
B. Cutaway views of HYATT Hy-Load separable inner race types.

C. Typical transmission application: Pilot bearing is BU-Z type without outer race, operating directly on hardened and ground gear bore, and an A-TS with inner race omitted operating directly on the shaft.



LINE FOR MACHINE DESIGN

SEPARABLE RACE ROLLER BEARINGS *with* INTERCHANGEABLE PARTS



Design engineers have come to recognize—and deal with—one stubborn fact in their business.

The stubborn fact: *Every bearing application has its own peculiarities.*

The way to deal with it: *Use the HYATT LINE!*

The core of the Hyatt Plan is simply this. Hyatt's separable race roller bearings—with interchangeable parts—permit you to improve machine design. They encourage improved machine design because they are adaptable to highly individual and unique applications.

Naturally, HYATT cylindrical bearings have more radial load-carrying capacity. Their true rolling action offers the lowest roller bearing friction. But the shrewd engineer looks beyond these basic life, load and speed relationships. He studies the installation, sealing, retainment, assembly and maintenance requirements of each individual bearing application.

In short, he uses the HYATT LINE for best results.

Pick up the phone the next time you want to review your bearing applications—for an overall production or performance advantage for your product. Call your nearest HYATT sales office.

You'll find the best roller bearing engineers anywhere at the other end of the line.

HARRISON, N. J. HUmbolt 4-4000
CHICAGO HArrison 7-8277
PITTSBURGH ATlantic 1-2927
DETROIT TRinity 3-7200
OAKLAND, CALIFORNIA TWin Oaks 3-5362

HYATT *HY-ROLL BEARINGS* FOR MODERN INDUSTRY

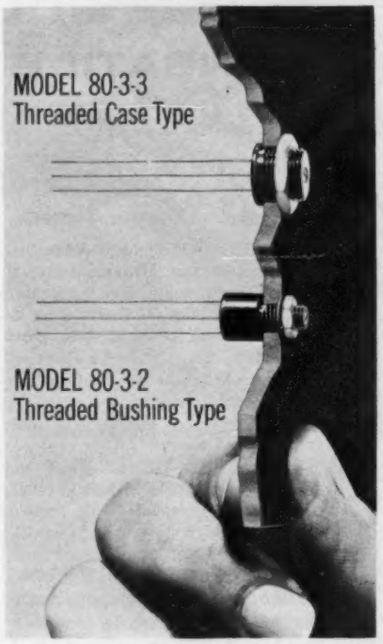
IN ROLLER BEARINGS, HYATT IS THE WORD FOR GM RELIABILITY

HYATT BEARINGS DIVISION • GENERAL MOTORS CORPORATION • HARRISON, NEW JERSEY

Circle 89 on Reader-Service Card for more information

Miniature Trimmers 342

Panel-mounting miniature trimmers with resistances ranging to 20K are obtainable in two models. Model 80-3-2 is ⅓ inch in diameter and has a 10-32 threaded bushing for panel mounting. Model 80-3-3 has a ⅜ by 32-inch threaded case and mounts within panel with very little projection front or rear. Both single-turn models have machined aluminum cases and the same internal features as Model 80-3-1, transistor-type, printed-circuit trimmer. All case styles are sealed to meet severe requirements of MIL-STD-202B, Method 104A, Condition A (hot-water immersion); MIL-E-



5272C, Procedure 1 (10 days humidity cycling); and MIL-STD-202B, Method 101A, Condition A (salt spray). Model 80 is approximately one-fourth the size of rectangular trimmers, yet offers high resolution since its resistance element is twice as long. Electrical specifications include: resistance range, 50 ohms to 20K; tolerance, ±5.0 percent; noise, 100 ohms ENR maximum per NAS-710; power rating, 1w at 50C; shock, 50G; vibration, 30G to 2000 cps; and load life, 1000 hrs.

Spectrol Electronics Corp., San Gabriel, Calif.

put HEINZE in your designs

HEINZE UNIVERSAL MOTORS

are VERSATILE

An endless variety of modifications are available on Heinze Universal Motors, such as stainless steel shaft . . . special cuts on shafts such as worms, pinions, screw threads, cross holes, flats, etc. . . . double shaft extension . . . cord sets . . . inline switches on cord sets . . . ventilated cases . . . fungus proofing . . . various type leads . . . choice of color.

In addition, Heinze Universal Motors are rugged to withstand tough applications, compact to fit limited space, have high starting and running torque, variety of mounting arrangements, are uniform in quality, keyed to high production, and are competitively priced.

Standard voltage rating is 115V AC/DC but motors are supplied for other voltages.

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HEINZE ELECTRIC COMPANY
685 Lawrence Street
Lowell, Massachusetts
SUB-FRACTIONAL HORSEPOWER MOTORS AND BLOWERS

HEINZE ELECTRIC COMPANY
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Please send catalog on Heinze Sub-Fractional Horsepower Motors and Blowers.

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Company.....
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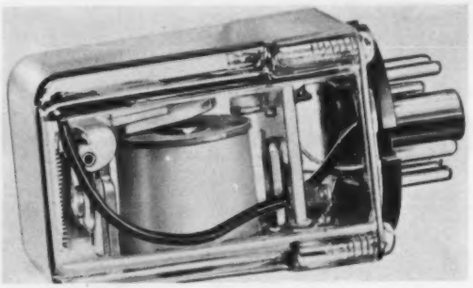
Circle 90 on Reader-Service Card

Plug-In Relay 343



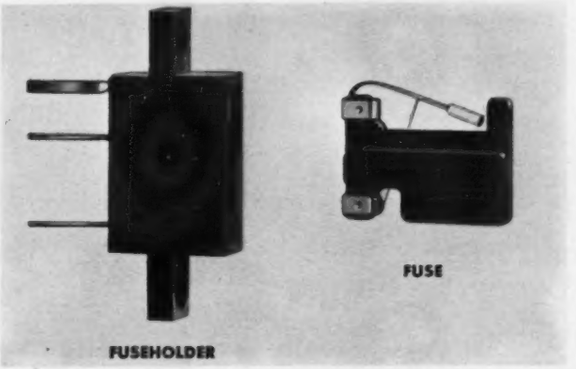
A small clapper-type relay with 8 or 11 -pin octal plug and transparent plastic enclosure provides long life reliability. Glass insulation, independently riveted coil terminals, built-in contact wipe and riveted contacts are features of the improved design. The relay is obtainable with 10-amp silver-alloy contacts, SPDT, DPDT and 3PDT; for 6, 12, 24 and 115v a-c or d-c actuation. Overall dimensions for the pictured relay are 1¾ by 1⅜ by 2-1/6 inches.

Magnecraft Electric Co., 3350 P W. Grand Ave., Chicago 51, Ill.

Visual-Indicating Fuse Holder 344

The GMT fuse and HLT holder are designed to permit multiple mounting of fuses in small places. Holders can be panel mounted on ¼-inch centers. Wafer thickness of fuse permits removal of any blown fuse without disturbing adjacent fuses. When fuse opens, it flashes a colored flag to draw attention to open circuit. Spring carrying flag also makes contact with an alarm circuit which can be used to light a lamp or ring a bell, or other signal at either panel board or remote location. Holder is designed to prevent incorrect insertion of fuse. Fuses are obtainable in sizes up to 10 amps.

McGraw-Edison Co., Bussmann Mfg. Div., University at Jefferson, St. Louis 7, Mo.



WHY AIR FORCE HAS ADOPTED MICROFILM FOR ENGINEERING DRAWINGS

Recently the Air Force issued new contract requirements of vital importance to companies that are doing—or intend to do—business with its various activities. In essence, the Air Force has made the use of microfilm mandatory for most engineering data and records relating to items delivered by contractors and their vendors.

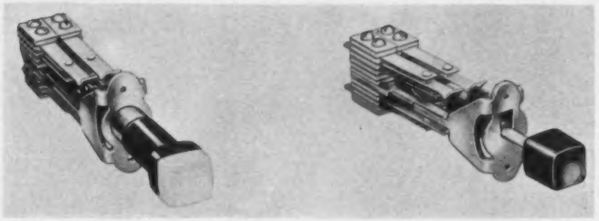
The new requirements (MCP-71-77) incorporate standards and specifications issued earlier by the Department of Defense for its Engineering Data Micro-Reproduction System. The Air Force move is indicative of the importance of microfilm to the government in saving time, money, and space.

The Air Force is convinced that working with microfilm is easier than working with paper, that it is more efficient and costs less. Filmwork, in other words, is easier and more practical than paperwork for engineering drawings and records.

This is not news to the many industries that use microfilm today. They know that microfilm is a highly efficient and effective production communication tool. They know that microfilm can do many jobs much faster and much more accurately, with almost fantastic savings in time and money.

3M makes microfilm easy to use

Push-Button Switches 345



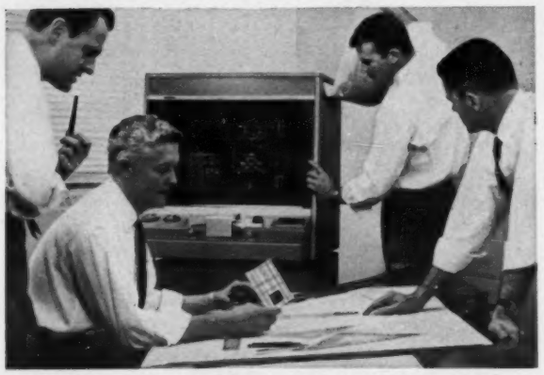
Single-station push-button switches offer ⅝-inch center mounting and each switch frame has two tapped screw holes for convenience of panel mounting. Series 15,000 illuminated are "Non-Lock" units that can be converted to "Push-to-Lock, Push-to-Release" function. Series 15,000L illuminated switches offer "Push-to-Lock, Push-to-Release" function and are convertible to momentary action. Series 5000, non-illuminated, non-lock switches can be converted to "Push-to-Lock, Push-to-Release" function. Non-illuminated Series 5000L "Push-to-Lock, Push-to-Release" switches can be converted to momentary action. Illuminated switches, Series 15,000 and 15,000L, feature square button design which provides side as well as front illumination, and a large area for engraving identification. Jewels of button are manufactured in "eye-rest" colors such as: red, white, yellow, green and others. Three lamp voltages are offered: 6, 28v, and Neon (115v a-c).

Switchcraft, Inc., 5555 N. Elston Ave., Chicago 30, Ill.

Pulse Light Source 346

This is a nano-second pulse light source, designated PEK 118. The unit emits a pulse of light one nano-second wide at the 50-percent point when excited by an electrical pulse, at a typical repetition rate of 100 pps. Size of the light spot is a disc approximately 0.010 inch in diameter. A number of sources can be excited at any one time in an array with the time jitter between pulses less than 0.2 nano-seconds. Time delay can then be added with delay cables. Pulse response of multiplier photo tubes can be investigated with this light source. The lights connect to a 51-ohm coaxial cable which will allow placement at the experimenter's convenience.

PEK Labs, Inc., 4024 Transport St., Palo Alto, Calif.



When data is on microfilm in FILMSORT Aperture Cards, facts that speed production are at your finger tips in just 90 seconds. And with a THERMO-FAX "Filmac" Reader-Printer you can take more than a look—you can take an enlarged copy in seconds.

Microfilm really became practical for industry only a few years ago when Minnesota Mining and Manufacturing Company introduced THERMO-FAX "Filmac" Reader-Printers. For the first time, the advantages of a reader and a printer were combined in one compact, low cost unit. Today there's a "Filmac 200" Reader-Printer that has a huge viewing screen, simple pushbutton operation, makes copy after copy in 18" x 24" size or half size prints of engineering drawings and data from microfilm in FILMSORT Aperture Cards. A "Filmac 100" Reader-Printer delivers 8½" x 11" copies in seconds, too.

FILMSORT Aperture Cards and "Duplicard" Copy Cards long used by government and industry are designed to meet military specifications and standards. These are the punch cards that make microfilm so easy to file, find, and use.

FILMSORT Microfilm Copiers, Mounters, and Readers are designed exclusively for FILMSORT Aperture Cards. They are engineered to make your microfilm system profitable.

Get the proof!

For complete information on how 3M makes microfilm so easy to use, for details about military microfilm standards and specifications, and for a free copy of "How to Put Microfilm to Work," mail this coupon today.

Please rush me ☐ information on how 3M makes microfilm so easy to use, ☐ details about the Department of Defense specifications, ☐ free copy of "How to Put Microfilm to Work."

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Company _____

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3M BRAND **MICROFILM** PRODUCTS

THE TERMS "THERMO-FAX" AND "FILMSORT" ARE REGISTERED TRADEMARKS OF MINNESOTA MINING AND MANUFACTURING COMPANY ... WHERE RESEARCH IS THE KEY TO TOMORROW

Dept. FCF-3131, St. Paul 6, Minn.

Circle 91 on Reader-Service Card for more information

DURA SEAL

THE ENGINEERED MECHANICAL SEAL *presents*

operation *-able*

depend-*able*

Dura Seals are custom engineered and assembled to provide customers with mechanical seals that will meet their specific applications.

interchange-*able*

many component parts of Dura Seals are interchangeable — a feature that extends greater versatility and reduces inventories.

avail-*able*

service interruption is minimized by prompt availability or replacement parts. Stocks are maintained at Baton Rouge, La., Borger and Houston, Texas, Kalamazoo, Los Angeles, Newark and St. Thomas, Ont., Canada.

FOR FURTHER INFORMATION ... WRITE FOR DURA SEAL CATALOG NO. 480-DN

The PERFECT SEAL TRADE MARK

DURAMETALLIC CORPORATION
KALAMAZOO, MICHIGAN

Circle 92 on Reader-Service Card

Thermal Delay Switch 347

A medium-priced delay relay switch, Model 200, has proved to be a reliable component in military and industrial fields with its guarantee to give a minimum of 500,000 operations at rated load. It is useful for: sequence operations, motor starting, holdover circuits, pulsing and flashing and delaying magnetic relays. The unit is hermetically sealed in a glass envelope with standard octal plug-in base. Delay ranges are 5 seconds to 3 minutes, with tolerances of ±15 percent. Ambient compensation is —65 to 125C. Standard models are rated at 3 amps, 115v a-c; 6 amps are available on special order.

Thermal Controls, Inc., 41 River Rd., North Arlington, N. J.

GRAPHITAR®

(CARBON-GRAPHITE)

FOR DEPENDABILITY

GRAPHITAR'S own character makes it dependable. A non-metallic engineering material, formed from carbon and graphite powders and a special binder, compacted under high pressures and furnaced at temperatures up to 4,500°F., GRAPHITAR possesses inherent characteristics that give finished parts exceptional dependability. GRAPHITAR'S natural heat resistance, for example, gives bearings, seals, vanes and rings exceptional dependability whenever dependability is one of the prime requisites.

There are other characteristics every bit as important to GRAPHITAR'S dependability. They include chemical and magnetic inertness, mechanical strength and adaptability to self-lubrication. Besides these natural characteristics, GRAPHITAR engineers can control porosity, strength and hardness to match GRAPHITAR'S physical properties to each individual application. It's little wonder that GRAPHITAR has become one of the design engineer's most versatile and useful materials.

In this laboratory test stand, oxidation-resistant GRAPHITAR parts are being checked under simulated operating conditions. Similar tests have proven that, when GRAPHITAR parts are exposed in oxidizing atmospheres at 1,200°F., they show only a weight loss of less than six percent after 200 hours.

In the Engineering Department of The United States Graphite Company, micro-photo studies are indispensable in the study of internal part structure. The Metallograph is just one of dozens of modern technological aids employed in both the quality control of production GRAPHITAR parts and in the research and development of new products. GRAPHITAR parts are engineered for dependability.

GRAPHITAR air/oil seals employed in today's high-speed turbojet engines have established an enviable record for operating dependability. Installed on the main shaft of the turbine, GRAPHITAR seals successfully withstand tremendous shaft speeds and generated heat.

GRAPHITAR bearings in the power reactor pumps of American nuclear submarines have compiled an outstanding record for dependability.

Unusually shaped parts of GRAPHITAR can be molded easily with today's modern techniques. Ears, face slots and outside diameter notches of friction disc above, left, were molded in one operation without need for secondary machining and finishing.

Do you have an application in which GRAPHITAR'S dependability can help solve a tough problem, reduce your costs and improve the operational life of your products? Our engineering staff can help you find out. Our field men can also give specialized, on-the-job consultation. Send for your free copy of Engineering Bulletin #20. Included is helpful information about the properties, characteristics and applications of GRAPHITAR.

THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW 2, MICHIGAN

GRAPHITAR® CARBON-GRAPHITE • GRAMIX® POWDER METALLURGY • MEXICAN® GRAPHITE PRODUCTS • USG® BRUSHES

R-294-2

Subminiature Film Capacitor 367

"Teflon" capacitors with low temperature coefficient and high stability have been developed for critical guidance systems in spacecraft and missile systems. Various temperature coefficients are available from 0 to 120 PPM/C for precise matching with precision resistors and inductors. Capacitors have self-healing characteristics for high reliability of metallized film capacitors but are superior in performance to metallized film and conventional "Teflon" foil capacitors. Tolerances to 0.1 percent are obtainable.

Component Research Co., Inc., 3019 S. Orange Dr., Los Angeles 16, Calif.

Test Jacks 349

Employing long-life beryllium copper contacts, "Press-Fit" "Teflon"-insulated test jacks offer an extended life in excess of 100,000 insertions and withdrawals with no appreciable increase in contact resistance. "Teflon" body is available in all standard EIA colors for identification of test points. Jacks are manufactured to fit standard 0.040, 0.050, 0.060 and 0.080-inch probes. Circuitry connection from test jack may be stamped lug, single or double turret, PW or other configuration to meet specific requirements. Terminal lug is plated gold flash over silver.

Sealectro Corp., 610 Fayette Ave., Mamaroneck, N. Y.

Circle 93 for Reader Service

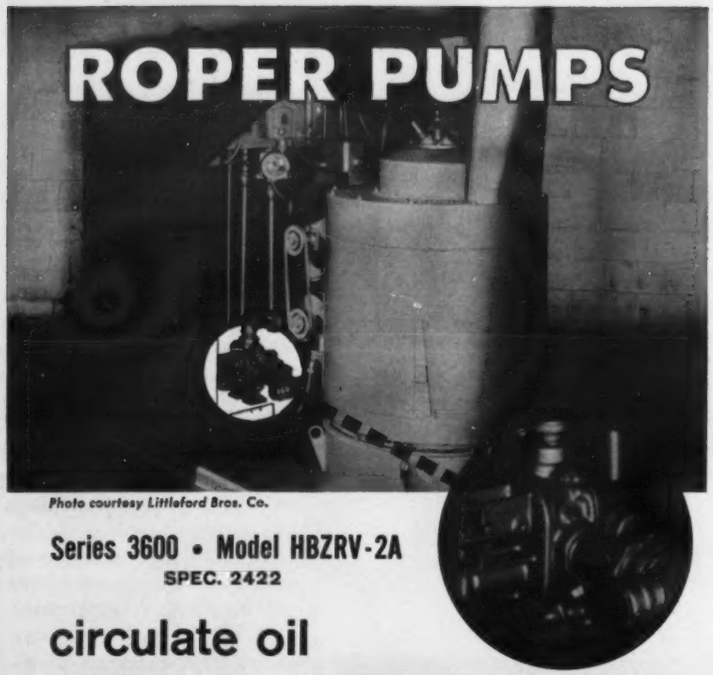


Photo courtesy Littleford Bros. Co.

Series 3600 • Model HBZRV-2A
SPEC. 2422

circulate oil uniformly through heating area of hot oil heater

Model OH 14 hot oil heater, manufactured by Littleford Bros. Co., produces 450°F hot oil for use in operations such as pre-stressed and ready-mixed concrete, and asphalt plant work. This positive displacement Roper Series 3600 pump moves 50 gpm of heat transfer oil smoothly and positively, circulating the oil thoroughly in heating area to eliminate cold or hot spots where deterioration of oil could occur. The relief valve of the pump protects against excessive oil pressure. The dependable, pulsation-free flow provided by the Roper pump has proved to provide the kind of performance manufacturers of original equipment want. Roper's service to the OEM field includes a custom design department equipped to design and build special pump equipment to match the changing needs of manufacturers.

Engineered for Years-Of-Service Operation

• **TWO MOVING PARTS**—equal sized, helical gears run in axial hydraulic balance for efficient operation. • **STEEL SHAFTS**—induction-hardened at all bearing and packing surfaces . . . pump can be supplied with upper or lower drive shaft. • **BEARINGS**—full support for pumping gears comes from four high-lead bronze or chrome-iron bearings. • **RELIEF VALVE**—built into face plate, prevents pressure build-up, permits stoppage of flow without halting pump . . . adjustable over 20-100 psi range.

For information about your specific pump needs contact your nearest Roper dealer
Send for "How to Solve Pumping Problems" booklet

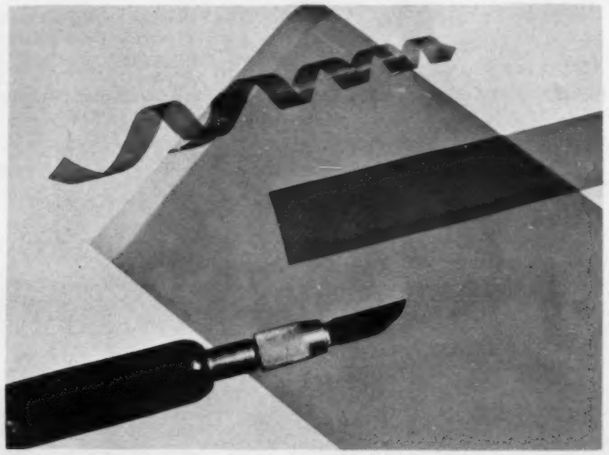
ROPER HYDRAULICS, INC.

Dependable pumps since 1857
COMMERCE, GEORGIA

Circle 94 on Reader-Service Card for more information

'Mylar' Metal Film — 350

A thin film of pure metals, approximately 50-millionths of an inch thick, is uniformly deposited on the surface of highly stable "Mylar". It can be used to line the inside of a cavity or a mode suppressor, or to wrap around shorting plunger in a cavity to reduce and suppress leakage. It may be cut to shape and selectively bonded to antennae to absorb spurious energy. Film is flexible, easily fabricated and easily laminated to plastics or metals. Using 0.001 "Mylar", sandwiched assemblies 0.0025 to 0.0030 inch in thickness can be made; 0.002-inch "Mylar" when sandwiched is 0.005 inch in total thickness. Film can be cut by scissors, template and sharp knife, or machined. Any value between 25 and 400 ohms/square can be supplied, and tolerance is ±10 percent. Standard values are 50, 100, 150, 200, 300 and 377 ohms/square. Silver contact areas can be provided for d-c contact. Samples are available.



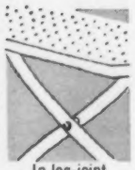
Filmohm Corp., 48 W. 25th St., New York 10, N. Y.

Film Tracing Pencil Refills — 351

These reproduction refills are designed and formulated specifically for tracings on polyester-based film. They are also suitable for work on cloth and vellum since they give good density, afford clean microfilms and erase without matte damage. Lead units are packaged in transparent plastic tube, and are manufactured in 6 deg of density, ranging from FTR 11 to FTR 66. Degree designation is marked on each refill containcr.

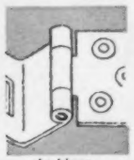
Joseph Dixon Crucible Co., Drafting Research Dept., Jersey City 3, N. J.

Use it as a hinge pin... SEL-LOK spring pin



In leg-joint of ironing board

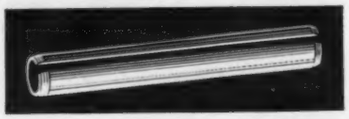
On valve handle



In hinge

- Swift fastening—just drill and drive
- Secure locking—won't work loose despite shock or vibration
- Eliminates costly tapping, reaming, peening, milling
- Can be reused repeatedly
- 101 uses—as keys, cotter pins, axles, hinge pins, wrist pins, stop pins, pivots, etc.

SEL-LOK spring pins are available in carbon and corrosion-resistant steel (from 1/16 x 3/16 through 1/2 x 4 in.) and beryllium copper (1/16 x 3/16 through 1/4 x 3 1/2 in.). See your SPS distributor or write for Bulletin 2670.



INDUSTRIAL FASTENER Division **SPS**

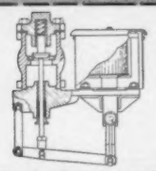
JENKINTOWN 6, PENNSYLVANIA

Circle 95 on Reader-Service Card for more information

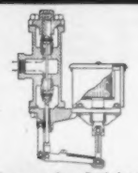
BIG LINE-UP BIG PERFORMANCE

Johnson Solenoid Valves are built for heavy duty service . . . handling, air, water, steam, heavy viscous liquids. No pilots or pistons; powerful leverage design opens smaller valves against 250 lbs. Because of the remoteness of the solenoid, temperatures up to 400° F. are easily handled without adverse effect on the solenoid coil. Bodies are bolted together. Explosion-proof models also.

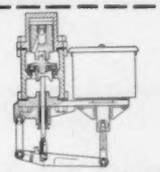
JOHNSON Direct Operated SOLENOID VALVES



Normally closed service, stainless steel valve and seat. Sizes 3/8"-3". Also for normally open service, and with Jenkins Disc.



3-way valve. Stainless steel valves and seats. Sizes 1/2"-1 1/2".



Dashpot construction, cushions closing to avoid water hammer. Jenkins Disc. Sizes 3/4"-2".

Write for Bulletin "V"

THE JOHNSON CORPORATION

831 Wood St., Three Rivers, Mich.

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breakthrough! electroplated Teflon*

Revolutionary new process offers:

- Full range of electroformable metals
- Unlimited variety of Teflon shapes
- No loss of Teflon's electrical properties
- Completely solderable platings
- Hermetic seal without adhesives
- Many new design possibilities

*DuPont-Trade Mark

Inquire:

PLASITRON CORP.

417 BRUCKNER BLVD., NEW YORK 54, N. Y.

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NEW QUICK-ACTING HAND KNOBS

ALUMINUM CAST IRON

CATALOG INSERT
NEW 16 PAGE CATALOG
CATALOG INCLUDES TRACING TEMPLATES

FREE! WRITE TODAY

JIG AND FIXTURE COMPONENTS

LATCH BOLTS
CAST IRON HAND KNOBS
ALUMINUM HAND KNOBS
QUARTER TURN SCREWS
SHOULDER SCREWS
JIG FEET (3 TYPES)
SPHERICAL WASHERS
FIXTURE KEYS
KNURLED HEAD SCREWS
TOGGLE SHOE CLAMPS & V-PADS

HOLD DOWN AND CLAMPING TOOLS

T-NUT & STUD SETS
STEP BLOCK & CLAMP SETS
FLANGED NUTS
CUT THREAD STUDS
TEE NUTS
COUPLING NUTS
ADJUSTABLE STEP BLOCKS
STRAP CLAMPS (PLAIN & STEP TYPE)

NORTH WESTERN **Northwestern** NORTH WESTERN

115 HOLLIER AVE., DAYTON 3, OHIO

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MAYLINE

V-Model Pedestal Table

Economical Drafting Tables of Wood!

For efficient, sturdy, economical, long lasting wood drafting tables investigate Mayline products. Tables are both attractive and practical. They are sturdily built of Oak, with solid Basswood steel end cleat tops, which can be tilted thru an angle of 50 degrees.

Prices for the V-Model pedestal tables start at $65.55, and $98.25 for the 4-Post tables. Your local dealer can tell you more about these fine drafting tables.

MAYLINE CO., INC.

529 NO. COMMERCE ST.

SHEBOYGAN, WISCONSIN

Wood 4-Post Table

MAYLINE MAYLINE MAYLINE

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The Best Miniature Soldering Iron In The World . . .

Precision MINIATURE SOLDERING IRON

110-115 volts
No Transformer
Weighs 1 ounce
6 1/2 inches long

$4.35 EACH IN LOTS OF 6

Tips extra

Precision . . . the best low wattage soldering iron made . . . has sealed element to maintain constant temperature around 626°F.

- Ultra-flexible 3-wire cord . . . grounded . . . 50 megohms between element and tip protects components and operator.
- Bright "safety" yellow handle stands more than 1000°F . . . stays cool.
- Easy slide-on tips . . . stay hot under production speeds . . . made of tungsten-copper alloy; nickel or iron plated; diameters from 3/32" to 3/16"; spade or chisel ends.

Irons furnished less plugs: heavy-duty 2 or 3-pronged plugs available.

Write:

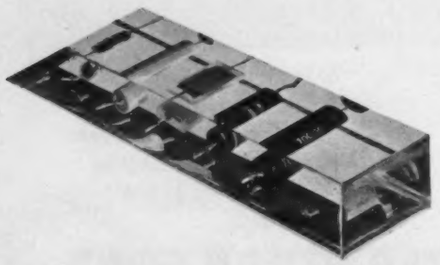
M. M. NEWMAN CORPORATION, Dept. 6

79 Clifton Avenue, Marblehead, Massachusetts

Circle 100 on Reader-Service Card for more information

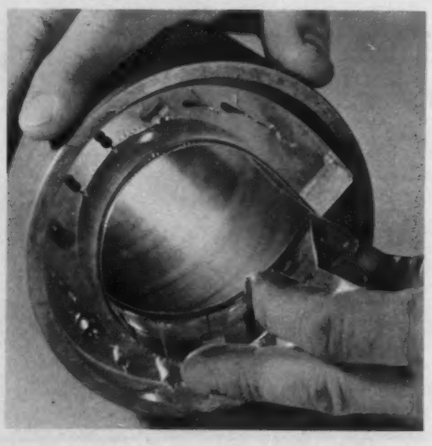
Transparent Silicone Resin Encapsulant 352

Visual inspection of circuits and components within potted, embedded or encapsulated assemblies is possible with "Sylgard 182" resin. Applied as an almost colorless liquid—after blending with its curing agent—the encapsulating material cures in place, even in totally confined enclosures, to form a transparent mass having high dielectric



properties, good moisture resistance and physical attributes of flexibility and toughness. Curing time can be varied by changing curing temperature. At 150C, it cures in 15 minutes; at 65C, in 4 hrs; and at 25C, in 3 days. No toxic fumes are given off during mixing or curing. Cured resin can be cut away with sharp knife so that defective components can be repaired or replaced. New resin poured over repaired area will adhere to original material, restoring encapsulant to original condition.

Dow Corning Corp., Midland, Mich.



CHRYSLER

NOW offers the most complete power train package in the industry at eye-popping prices!

Now Chrysler M & I offers the most complete engine and power train package in the industry! And stands behind it with the industry's fastest and best field service network—and field service warranty.

New Chrysler industrial engines include nine basic models—170 to 413 cu. inch displacement—famous for long life and trouble free performance in the toughest applications. Most are available in heavy duty standard and heavy duty premium versions to meet your specific power requirements.

Chrysler M & I engines have a new, highly compatible running mate. Chrysler-Perkins, liquid cooled diesel engines—30 to 130 h.p. Product of the world's largest diesel engine manufacturer. Sold and serviced in U.S. by Chrysler M & I.

New Chrysler M & I power train components include (1) Power Torque—a combination torque convertor and power-take-off unit; available in straight line PTO, right angle PTO, transmission adaptation. (2) Automatic transmissions with 10¾" or 11¾" torque convertor. (3) Rear axles. Chrysler's compact, lightweight Alternator is also available.* All are priced to reflect the mass production capacity of Chrysler Corporation.

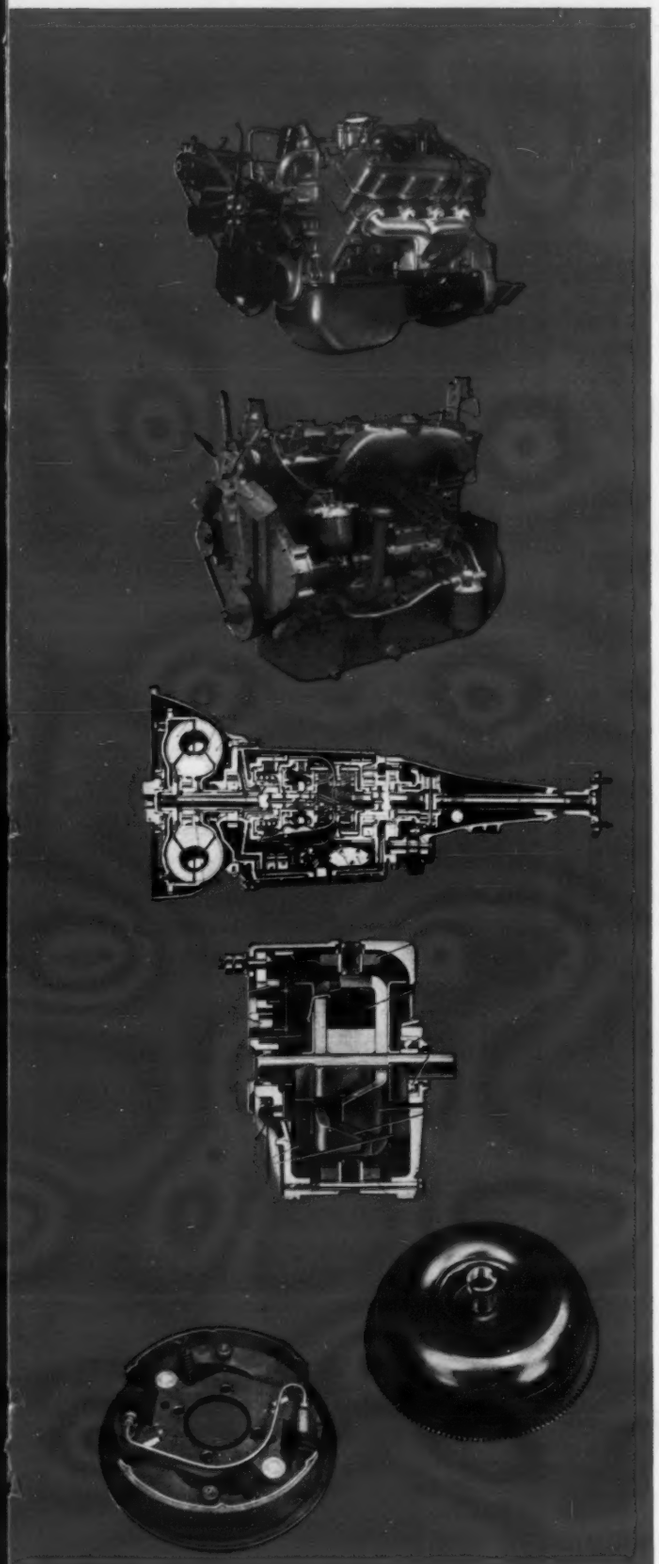
Send for specifications and installation drawings.

**All component parts manufactured by Chrysler Corporation—both automotive and truck versions—available through Chrysler M & I Division. Including steering gears, power steering pumps, torque convertors, suspension parts, starters, truck cabs, etc. Detailed information on request.*

CHRYSLER

MARINE AND INDUSTRIAL ENGINE DIVISION

CHRYSLER CORPORATION • DETROIT 31, MICHIGAN



CHRYSLER GASOLINE ENGINES

Nine basic models; two OHV 6's; seven V-8's. 170 to 413 cu. inch displace.

PERKINS DIESEL ENGINES

Six basic models; 3, 4 and 6 cylinder. 30 to 130 hp.

AUTOMATIC TRANSMISSIONS

10¾" or 11¾" convertor versions. Input capacity up to 230 or 413 cu. inch displace. engines.

ALTERNATOR 35 OR 40 AMP

Provides 10 amp output even at engine idle. Lightweight, compact, durable. Double the life expectancy of ordinary DC generator.

TORQUE CONVERTORS

10¾" and 11¾".

BRAKE ASSEMBLIES

Automotive and truck sizes.

Chrysler M & I Engine Division
Dept. D-3, P. O. Box 1836, Detroit 31, Michigan
Please send me specifications and installation drawings as checked.

☐ Chrysler Engine ☐ Perkins Diesel Engines
Approx Horsepower_____ Application_____
☐ ☐ Automatic Transmission ☐ ☐ "Power Torque"
☐ ☐ Alternator ☐ ☐ _____ (Other)

NAME_____TITLE_____
COMPANY_____
ADDRESS_____
CITY_____ZONE_____STATE_____

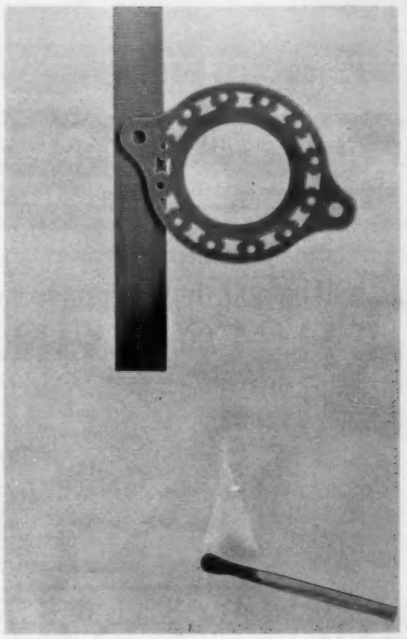
Circle 101 on Reader-Service Card for more information

99.999-Percent Pure Silver 353

Silver for semiconductor and other applications is offered to industry 99.999+-percent pure. The only spectrographically detectable elements are iron, copper, silicon and manganese—all less than one part per million each. Material is available in fine crystalline powder. It can also be produced in vacuum-cast ingots or rolled into strip or foil to customer specification.

Accurate Specialties Co., High Purity Metals, Inc., 340 Hudson St., Hackensack, N. J.

Glass-Fabric Epoxy Laminate 354

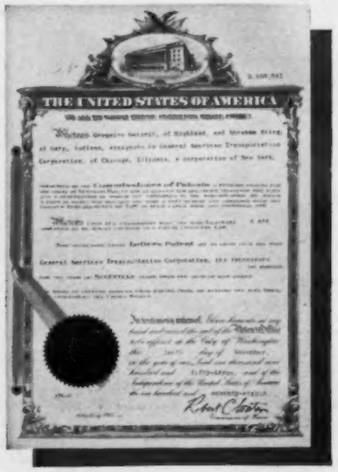


NEMA G-10 glass-fabric epoxy laminate offers flame retardance, high-quality cold punching and increased solvent resistance. The grade is offered copper-surfaced as "Di-Clad 614" or plain as "Dilecto 614". Grade 614 meets NEMA specifications for G-10 as well as NEMA FR-4, a fire-retardant G-10. Military specification MIL-P-13949B, Type GF, is met by "Di-Clad 614"; "Dilecto 614" is pending approval under MIL-P-18177B as Type GEE.

Continental-Diamond Fibre Corp., Newark, Del.

a Reminder

to those who use chemical nickel alloy plating:



There is only ONE Kanigen®

and 29 patents prove it

There are no substitutes for Kanigen—no other process that applies a hard, corrosion-resistant nickel alloy coating without the use of electricity as Kanigen does.

With Kanigen, you can plate anything from a small relief valve to a 20,000 gallon tank car with a virtually non-porous, uniform coating.

How can you be sure of getting Kanigen? Only one way—by calling General American or one of its licensees. For further information write:

Kanigen Division
GENERAL AMERICAN TRANSPORTATION CORPORATION
135 South LaSalle Street
Chicago 3, Illinois
Offices in principal cities

LICENSEES

INDUSTRIAL KANIGEN CORPORATION
1421 Park Avenue
Emeryville, California

KEYSTONE CHROMIUM CORPORATION
1095 Niagara Street
Buffalo, New York

KEYSTONE METAL FINISHERS, INC.
22 Raydol Avenue
Secaucus, New Jersey

Circle 102 on Reader-Service Card for more information

Metal-to-Metal Adhesive 355

A "dry" adhesive designated "Metlbond 408" has been qualified as a Type I, Class II sandwich adhesive under MIL-A-25463, and as a metal-to-metal bonding agent under MIL-A-005090D. The material is supplied in continuous rolls, 18 inches wide, comprising 125 sq ft. It is a dry, 100-percent-solids, modified-epoxy resin system containing no solvent or cloth-type carrier. As supplied, the adhesive weighs approximately 0.055 lb per sq ft and produces a glue line with an average thickness of 0.005 inch. Additional plies of the adhesive may be used for extra strength when particularly rough surfaces are encountered. As a metal-to-metal adhesive, "408" exceeds the minimum requirements of MIL-A-005090D. For example, the specification calls for a room-temperature shear strength of 2500 psi; "408" demonstrates an equivalent strength of 6500 psi; at 180F, the material has a shear strength of 3100 psi, and at —67F it has the same value as it has at room temperature.

Narmco Materials, Div. of Narmco Industries, Inc., 600 Victoria St., Costa Mesa, Calif.

Flexible Magnetic Vinyl 356

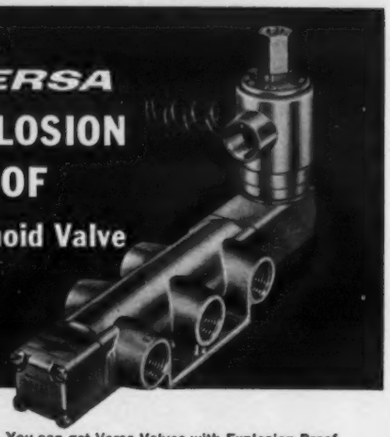
Vinyl magnetic strip is produced in 9 standard colors and can be manufactured to meet any color specification. Colors are obtained with a vinyl paint coating which becomes an integral part of the magnetic strip. The glossy surfaces are non-staining, can be wiped clean with a damp cloth, are non-toxic and color-constant. Color range includes white, black, yellow, orange, red and two shades each of blue and green.

B. F. Goodrich Industrial Products Co., 714 W. Olympic Blvd., Los Angeles 15, Calif.

VERSA

EXPLOSION PROOF

Solenoid Valve



■ Now . . . You can get Versa Valves with Explosion Proof Solenoid actuation. This new actuator is available on any series "V" and "T" Valves in sizes from ⅛" NPT to ½" NPT in 2-, 3-, 4- and 5-way types, in side port models or sub-plate models for manifold mounting, and for pressures from partial vacuum to 500 PSIG. ■ These superior valves are completely enclosed units, having no external moving parts and they are virtually trouble free. ■ All Versa Valves are triple pressure and functionally tested under water for guaranteed leakproofness. ■ For complete information write today for Bulletin #660.

VERSA Valves

VERSA PRODUCTS COMPANY, INC.

150 COOLIDGE AVE., ENGLEWOOD, NEW JERSEY

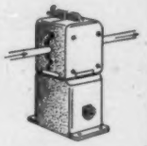
Circle 103 on Reader-Service Card for more information

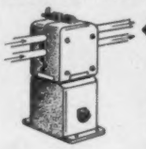
PUMPING IDEAS

POSSIBLE ONLY with a SIGMAMOTOR PUMP

MOVE CORROSIVE LIQUIDS

Material being pumped never comes in contact with pump mechanism. Wave-like motion of steel fingers forces material through Tygon tubing. By changing size of tubing, capacity can be increased or decreased. Pump housing opens for removal and insertion of tubing.



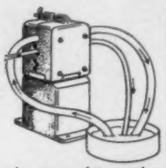


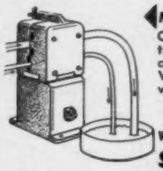
PUMP 2 OR 3 DIFFERENT LIQUIDS SIMULTANEOUSLY

Some models will accommodate up to four tubes so that four different liquids can be passed through the pump at one time without danger of contamination.

FEED AND MIX

One or more tubes can be feeding material to a mix while a larger tube is recirculating the liquid to produce agitation and thorough mixing. Viscous materials can be pumped without danger of gumming or plugging. Remove tube and pump is clean.





METER ADDITIVES

One or more additives can be pumped to a solution in the exact amount desired by selecting the correct size of tubing and regulating pump speed. Various controls can be incorporated to close valves ahead of pump.

Capacities from 0.5 cc. per min. to 4.5 G.P.M.

Write for complete information on sizes and capacities.

SIGMAMOTOR, INC.

30 N. Main Street • Middleport, N. Y.

Circle 104 on Reader-Service Card for more information

TYPE "FT"

TYPE "FTS"

CURTIS TERMINAL BLOCKS for EVERY PURPOSE in Factory Assembled and Kit Form

SEE THEM BOOTH 2315

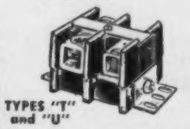
Radio Engineering Show

New York Coliseum

New York City

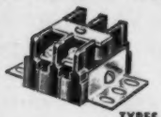
March 20-23

Call your area representative

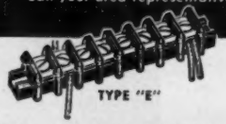


TYPES "T" and "U"

TYPE "H"



TYPES "CDM and CT"



TYPE "E"

TYPE "K"

TYPE "M"

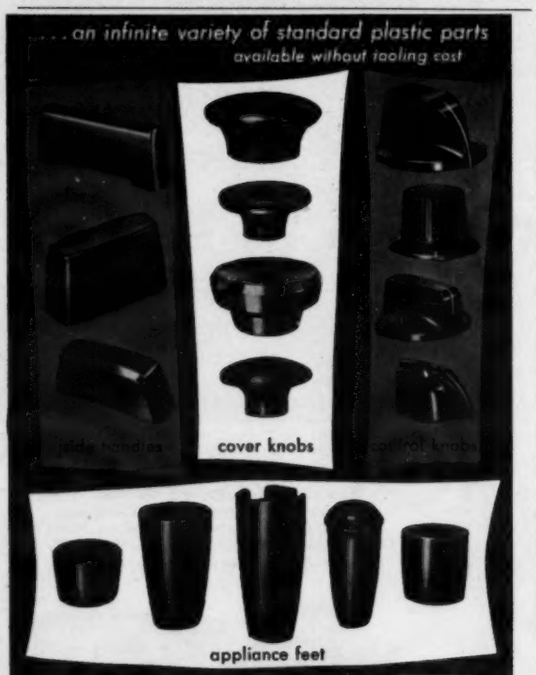
TYPE "MT"

CURTIS DEVELOPMENT & MFG. CO.

3220 North 33rd Street, Milwaukee 16, Wisconsin

Circle 105 on Reader-Service Card for more information

. . . an infinite variety of standard plastic parts available without tooling cost



cover knobs

appliance feet

HARRY DAVIES MOLDING CO.

1428 N. Wells Street, Chicago, Ill.

FREE CATALOG + samples on request

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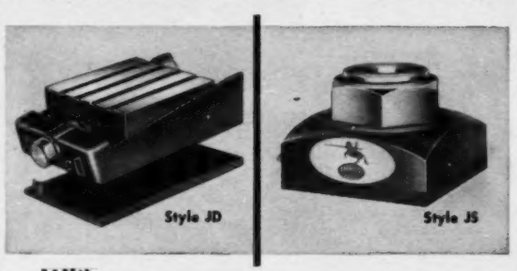
DEPENDABLE MACHINE SUPPORT!



Style JD

Style JS

With

EMPCO

LEVELING JACKS

For better machine performance set your machines level and keep them level! That's the key to increased production with less maintenance! EMPCO Leveling Jacks provide a solid, adjustable support for machine tools, large surface plates, tool room, and production equipment of all types. Easily installed and located, EMPCO Jacks keep your equipment level and stable—keep maintenance at a minimum.

VI-SORB Mounting Pads, optional with EMPCO Jacks, control vibration from within the machine itself and reduce transmitted vibrations. Available in six styles and 25 models there's a EMPCO Jack and VI-SORB Mounting Pad for your every machine leveling requirement!

WRITE TODAY FOR ILLUSTRATED BULLETIN AND PRICES!

EMPCO PRODUCTS

THE ENTERPRISE MACHINE PARTS CORPORATION

2729 JEROME AVENUE • DETROIT 12, MICHIGAN

Circle 107 on Reader-Service Card for more information

NOW! For miniaturized assemblies...

HALLOWELL steel collars in microsizes

- 1/16, 3/32, 1/8 inch bore
- Fitted with UNBRAKO set screws for positive locking action
- Precision machined from finest bar stock
- Extremely versatile—used as thrust collars, locking collars, spacers, cam operators, indexing devices, etc.

Send for Bulletin 868—complete information on all sizes of HALLOWELL steel and cast iron collars.

INDUSTRIAL FASTENER Division sps

JENKINTOWN 6, PENNSYLVANIA

Circle 108 on Reader-Service Card for more information

Paste Solder 357

A paste solder—solder alloy, flux and neutral binders in stable suspension—is designed primarily for tough-to-solder stainless-steel materials. Dipping in water while hot or soaking in water while cold will remove active residual particles after soldering. This paste solder is suitable for use with automatic applicators which make complete automatic soldering possible. With the development of this material, soldering of tough grades of stainless steel such as 304 and 430 is easily and inexpensively automated using this process. Samples of stainless-steel solder paste are available.

Fusion Engineering, 17921 Roseland Ave., Cleveland 12, Ohio.

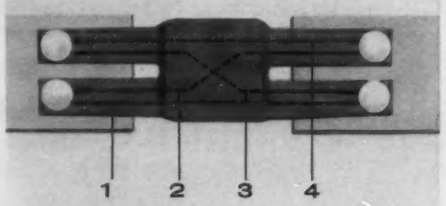
Electroplated 'Teflon' 358

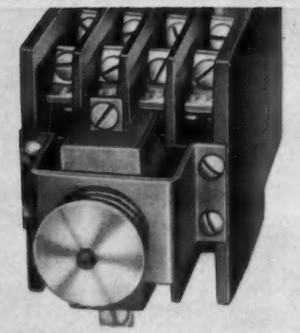
A process for plating metals directly on "Teflon" opens up many new design possibilities in the electronic and plastic fields. The process permits use of the entire range of electroformable metals, both base and noble, on an unlimited variety of "Teflon" shapes. This provides complete adhesion with no loss of "Teflon's" electrical properties, and even permits soft-soldering without damage. Due to the bonding method employed, such a soldered joint becomes a hermetic seal at a wide range of temperatures, governed only by physical size and geometry of application.

Plasitron, Inc., 417 Bruckner Blvd., New York 54, N. Y.

Another Cutler-Hammer first! Up to 24 poles in an area less than the size of a dollar bill.

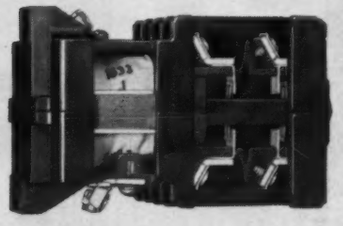
New contact reliability. Parallel bifurcated contacts, which allow four current paths instead of one, provide infinitely greater circuit reliability . . . liberally designed so any current path carries full relay rating.





At last! "Mechanical memory" latch as reliable as the relay itself! No adjustment ever needed. Add latch at any time.

New simplified design! Cutaway view shows basic simplicity. Coil vacuum impregnated to resist damage from humidity, vibration, electrical stress. Terminals can be screw or spade type.



CONTROL

Space savingest relay you've ever seen: New Cutler-Hammer "Compact 300"

Versatile 300 V. control relay is so reliable it's permanently sealed!

Here is the best answer yet to the need for an extremely reliable, small-size 300 V, 6 amp., industrial relay — the new "Compact 300" from Cutler-Hammer.

Every detail known that affects relay reliability has been improved in the "Compact 300." Bifurcated contacts which make possible *four* current paths rather than one, add millions of operations to the "Compact 300's" electrical reliability.

In fact, we're so confident of its electromechanical reliability, we permanently enclose the "Compact 300." And, if it should be damaged by a fault current, you throw it away and replace it with a new one. Its low price makes this an economical, practical maintenance procedure.

Now think of the space you can save with the "Compact 300." It controls up to eight circuits in panel space only 2" wide by 2¾" high. 2, 3, 4, 6 and 8 poles with any combination of N.O. or N.C. contacts are available, of course.

At any time, you can add "mechanical memory" latch with a life equal to the life of the relay. No adjustments are ever necessary. Contact your Cutler-Hammer distributor for details on the "Compact 300" or send for Pub. LO-79-F272.

What's new at Cutler-Hammer? New, better products, like the 300 V. relay are coming steadily from our new, expanded plant facilities. We're ready now to help you take care of the great industrial growth of the future. If you are planning ahead and need electrical control assistance, contact the nearest Cutler-Hammer sales office.

WHAT'S NEW? ASK...

CUTLER-HAMMER

CONTROL

Cutler-Hammer Inc., Milwaukee, Wisconsin • Division: Airborne Instruments Laboratory • Subsidiary: Cutler-Hammer International, C. A. Associates: Canadian Cutler-Hammer, Ltd.; Cutler-Hammer Mexicana, S. A.

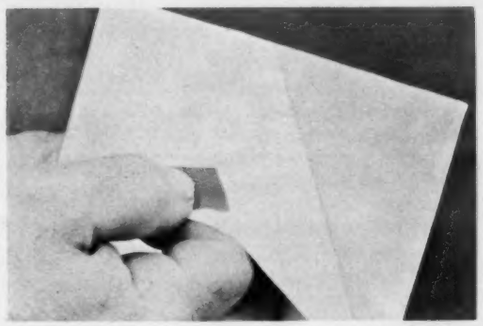
Circle 109 on Reader-Service Card for more information

Epoxy Rod 359

Formulated to meet rigid specifications when used for precision wirewound resistors under MIL-R-93B, this plastic material is offered in a wide selection of various types and percentages of inert fillers. Material is distinguished by its high volume resistivity at high temperatures—0.19 x 10^{16} at 180C—and also by its high heat distortion—133C at 264 psi. Rods can be machined economically using conventional shop techniques. Resistor bobbins and thin-wall shells machined from this material give good evidence of maintaining high dimensional stability.

Boonton Molding Co., Boonton, N. J.

Vibration-Damping Tape 360



A foam, plastic and high-tack adhesive is combined in one material to provide a pressure-sensitive tape that reduces resonant vibration and accompanying noise by converting vibration energy into heat. Conformable to rough and irregular surfaces, tape can be applied with finger pressure against its plastic backing. Damping occurs when embossed vinyl plastic backing forces specially compounded polyurethane foam to absorb vibrational energy. Plastic backing serves as constraining layer. Foam is between backing and adhesive. Adhering adhesive keeps foam in close and permanent contact with vibrating object. Tape is also moisture and flame resistant and meets all Federal Aviation Administration's (FAA) regulations covering flame-resistant aircraft materials. Thickness of tape is 0.250 inches and weight is 0.250 lb per sq ft. A single layer is designed to provide good damping on steel and aluminum as thick as 0.060 inches. Damping of 0.125-inch thick material is possible with two layers of tape. The material is available in 6-inch widths and lengths up to 8 ft.

Minnesota Mining & Mfg. Co., 900 Bush Ave., St. Paul 6, Minn.

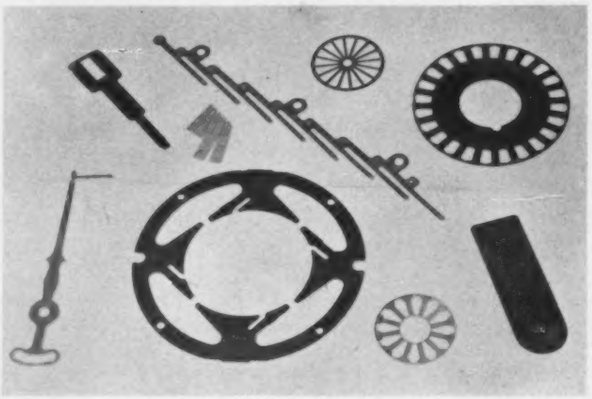
This submarine periscope support bearing custom engineered by ITI for Nortronics, a division of Northrop Corporation, is indicative of today's changing bearing concept. By designing limit stop lugs as an integral part of the 17-7 PH stainless steel raceways, available periscope azimuth sweep was increased from 200 to 300 degrees. This is just one example of how engineers are turning to special bearings to solve the formidable problems created by advanced mechanical design. Materials, proportion and geometry may be altered to minimize weight or space, to permit operation at extreme temperatures, or without lubrication. For information on how ITI can design and produce in any quantity other special bearings write for Bulletin AFB-2.

ITI

INDUSTRIAL TECTONICS, INC.
manufacturers of precision balls and bearings
BEARING DIVISION | 18301 SANTA FE AVENUE, COMPTON 16, CALIF.

Circle 110 on Reader-Service Card for more information

Photo-Mechanical Duplication 361

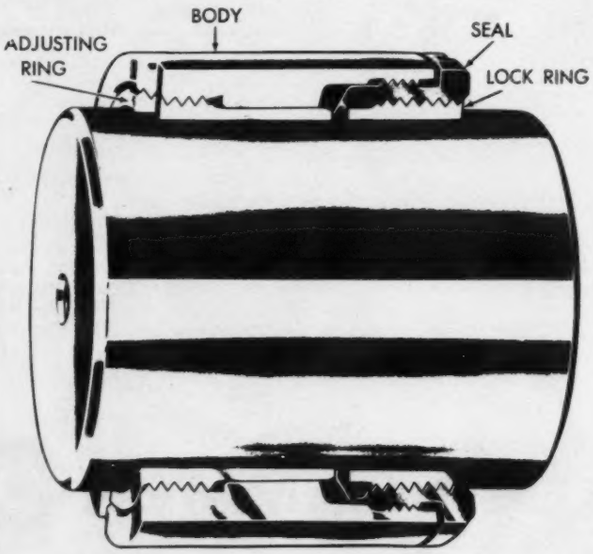


This process makes it possible for a number of manufacturers to produce small miniature parts with low tooling cost. Small as well as large precision thin parts may be produced from practically any sheet alloy. Such thin parts produced under this process are held to close tolerances on all requirements. Under this method, no hardness or brittleness is introduced in the finished part, assuring fracture-free finished parts of accurate flatness. Evaluation samples are available.

Dayton Rogers Mfg. Co., 2824 13th Ave. S., Minneapolis 7, Minn.

Hydraulic Seal 362

An all-metal seal for dynamic applications to handle hydraulic pressure under extremely adverse conditions has performed satisfactorily at temperatures up to 530F and at pressures to 6000 psi. The seal does not require close tolerances, is self-compensating for reasonable misalignment and side loads, and has low break-out force. Design of seal features a blunt knife edge with controllable unit load that seals pressures while holding load on radial edge of seal as low as possible, thereby keeping break-out force low.



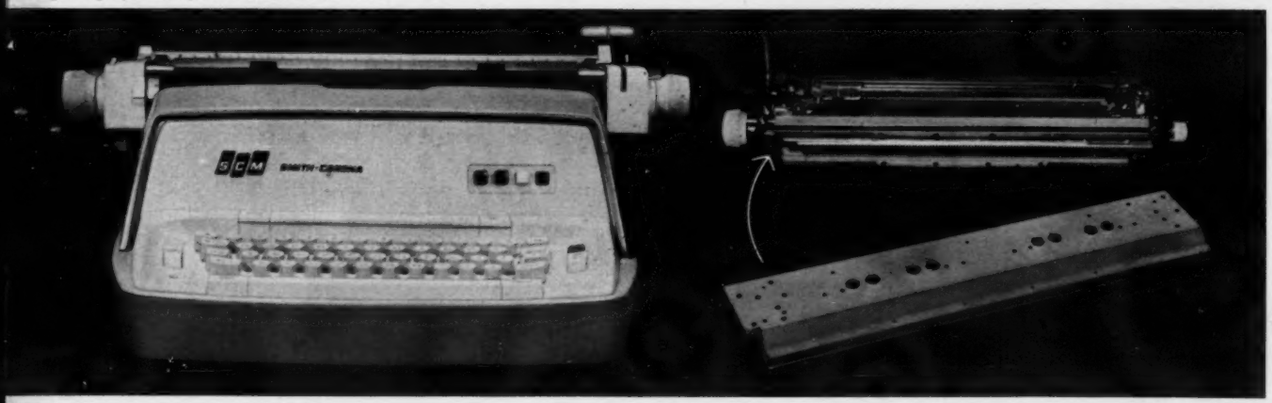
B. F. Goodrich Co., 5400 E. Olympic Blvd., Los Angeles 22, Calif.

Circle 111 on Reader-Service Card

Automotive transmission stator blade

Lightweight precision part for Smith-Corona "400"

Printer's furniture, The Challenge Machinery Company



ELIMINATE MACHINING, CUT PRODUCTION COSTS WITH MAGNESIUM PRECISION EXTRUSIONS

These close-tolerance parts were produced with no machining costs! They're Dow precision magnesium extrusions which require only end trimming or cutting to length before use . . . and where transverse holes are needed, drilling and tapping. Dow precision magnesium extrusions help manufacturers cut production costs, while providing tolerances as close as ± .001 inch on critical cross-sectional dimensions, dimensional stability and light weight. There is no machining on the typical parts above . . . component for the ultra-modern Smith-Corona "400" Office Electric Typewriter; The Challenge Machinery Company's printer's furniture; and automotive transmission stator blade. Precision magnesium extrusions can be produced with sharp V's, thin notches, and accurate serrations. Complex parts can be given a consistent precision fit. For information, write to THE DOW METAL PRODUCTS COMPANY, Midland, Michigan, Merchandising Dept. 1104AV3-13.

DOW

THE DOW METAL PRODUCTS COMPANY
Division of The Dow Chemical Company

DOW

NEW DOW MAGNESIUM ALLOY ZE10A

high welded joint strength and no stress relief!

New Dow magnesium alloy ZE10A needs no post-welding stress relief. This strong sheet alloy is ideal for fabricating containers, vehicle bodies and other structures . . . and for field repair operations where stress relief can be a real problem.

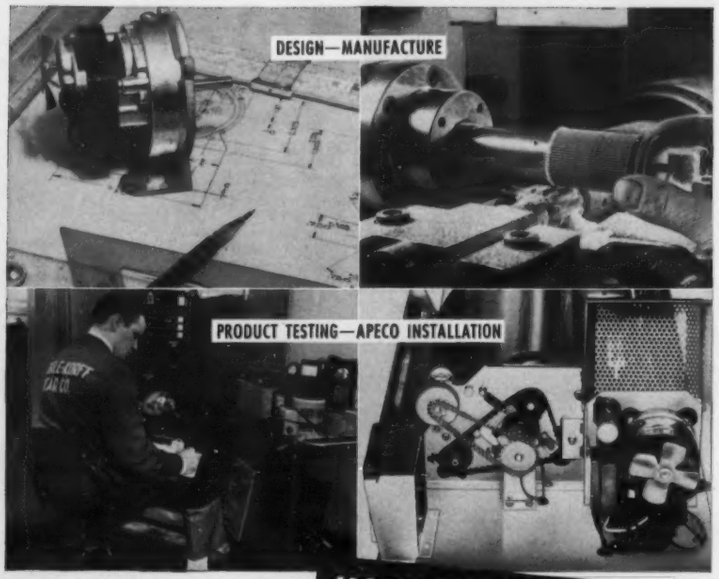
ZE10A provides very high welded joint strength, important in butt welding of plates. The result—strong, stiff weldments of very light weight . . . with greater capacity, pound-for-pound, than structures made from any other metal!

To weld ZE10A sheet to extrusions, use Dow extrusion alloy ZK21A. No stress relief required. For further information and data, write THE DOW METAL PRODUCTS COMPANY, Midland, Michigan, Merchandising Dept. 1152AV3-13.

ZE10A makes light, strong containers, like this Tote Bin, built by Tote Systems, Inc., Beatrice, Neb., a subsidiary of Hoover Ball and Bearing Company.

DOW

THE DOW METAL PRODUCTS COMPANY
Division of The Dow Chemical Company
Midland, Michigan



HOW MERKLE-KORFF "PERFORMANCE BALANCE" PAYS OFF IN FHP GEARMOTOR DEPENDABILITY

Performance Balance is the perfect mating of Merkle-Korff motor and gearing to your specific application. It prevents *money waste* and *equipment damage* through overpowering, and eliminates *operating failures* due to occasional low voltages and the many hidden hazards of underpowering. Either, or both, the result of "underknowledge" of the drive system by a gearmotor manufacturer.

Merkle-Korff's total understanding based upon 50 years of experience in supplying the right power unit for any given job is available to you. We will, and do, develop and manufacture gearmotors designed to your individual requirements, not only to perform satisfactorily, but to do so at lowest cost. Merkle-Korff service is unique in this respect.

Performance Balance, therefore, is not just a play on words. It is your guarantee of on-the-job performance and dependability. Thousands of cases exist proving the worth of *Performance Balancing*.

Literature is available. Better still, send us your drawings or product sample so our Applications Engineers can give you a complete evaluation of motor and entire drive system! There is no obligation.

MERKLE-KORFF
MK
GEARED MOTORS
MERKLE-KORFF GEAR CO.
217 NORTH MORGAN STREET • CHICAGO 7, ILLINOIS • MOnroe 6-1900

Circle 112 on Reader-Service Card for more information

Frequency Response Calculator 363

A pocket-sized calculator is designed for engineers who must interpret or plot frequency response curves. The frequency response calculator eliminates the need for slide-rule computations or complex chart references when plotting a frequency response curve as a means of evaluating an amplifier, controller, transducer, power positioner, or other control device.

Hagan Chemicals & Controls, Inc., Hagan Center, Pittsburgh 30, Pa.

Experimenters' Tool Kit 364

For the convenience of electronic kit builders, as well as home handymen and experimenters, the TK-6 will easily handle construction of any electronic kit available. Included in the kit are: long-nosed pliers; diagonal sidecutter; adjustable wire-stripper; 40w soldering iron; and two screwdrivers. Tools are of high quality and are enclosed in a see-through carrying-storage case, which has a separate compartment for each tool.

PACO Electronics Co., Inc., 70-31 84th St., Glendale 27, L. I., N. Y.

Circle 113 on Reader-Service Card

do you need a higher efficiency small blower wheel?

LAU®

FIRST CLASS
PERMIT NO. 182
DAYTON, OHIO

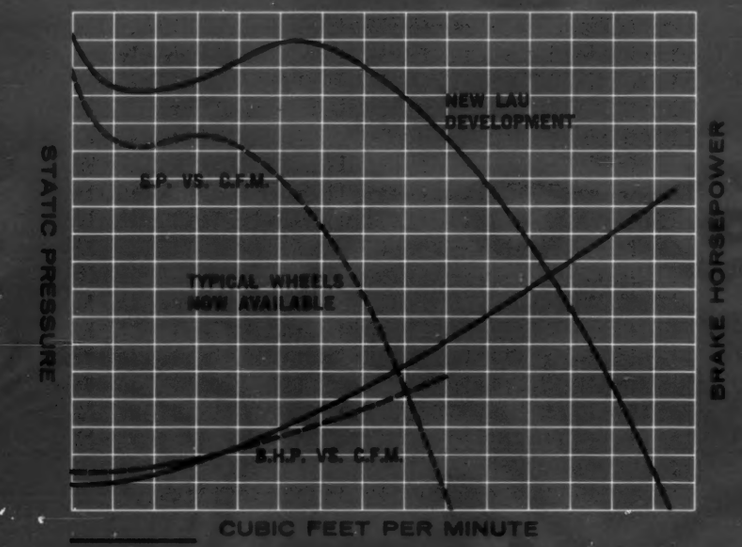
BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

Mr. William H. Wentling, Director of Engineering
THE LAU BLOWER COMPANY
2027 Home Avenue
Dayton 7, Ohio

INTRODUCING A NEW LAU ENGINEERED BLOWER WHEEL... 4¾" TO 8½"

BLOWER PERFORMANCE



NEW LAU DEVELOPMENT

TYPICAL WHEELS NOW AVAILABLE

Lau Engineering has successfully developed a blower wheel that outperforms any wheel of comparable size tested. This powerful, compact unit is specifically designed for installation in room air conditioners but can be used effectively in most appliance applications. Lau "spun" construction contributes greatly to the wheel's structural rigidity and to a very high CFM to WATT ratio.

This new Lau wheel is offered in a customer's choice of aluminum, cold rolled steel or zinc grip and in a range of diameters, blade lengths, bore sizes and back plate designs.

For a complete engineering data file on this new Lau high performance wheel send the attached, postage paid card to Wm. H. Wentling, Director of Engineering, The Lau Blower Company, 2027 Home Ave., Dayton 7, Ohio.

Mr. William H. Wentling, Director of Engineering
THE LAU BLOWER COMPANY
2027 Home Avenue
Dayton 7, Ohio

Please check

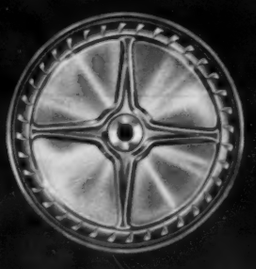
☐ send complete engineering file ☐ we would like to see sample wheel

Name_____

Position_____

Company Name_____

Address_____



Single inlet wheel is standard. Double inlet (wheels back to back) is available. Choice of solid, pied-out or coned back plate.

Microphone Kit 365

A do-it-yourself, high-fidelity, ceramic microphone kit is offered to audio enthusiasts, amateurs, citizen banders, educators, sound laboratories and professional groups. Since the kit offers technical and economical advantages, the user will gain valuable knowledge of how such a microphone is constructed and operates. The kit will also enable the experimenter to customize frequency response of microphone to meet his own particular requirements. The Mark III microphone is designed around a ceramic element which develops unusually high output and is unaffected by heat or moisture. It is housed in a lightweight metal case. Technical specifications are: sensitivity, 100 cps; recommended load, 5 megohms; and frequency response, 30 to 10,000 cps.

CBS Electronics, Div. of Columbia Broadcasting System, Inc., Danvers, Mass.

Personal File Cases 366

"AMFILES" are offered in two models, 850 and 650. Model 850 is designed for compartmental filing, offering a standard letter-size compartment plus 3 smaller spaces for filing cancelled checks, insurance policies and No. 10 envelopes. Included is a set of 8 file folders, ruled inside for record keeping; a set of 9 guides for small compartments; and 84 extra gummed titles. Model 650 offers a set of 8 vertical file folders, ruled inside for record keeping, and includes a set of 84 extra gummed title labels. Both models are made of binder's board, finished in cherry red, sea green or navy blue. All files feature crystal-clear plastic handles with metal hinges, and an extra-heavy snap latch.

Amberg File & Index Co., Kankakee, Ill.

Circle 113 on Reader-Service Card

Is your secretary better equipped than your engineers or draftsmen?

She deserves the best, bless her, and often gets it—but your skilled *draftsmen*, too, need today's tools to cope with today's demands.

Your draftsmen, your productivity, deserve new Hamilton space-and-time-saving equipment — from Ridgway's

Even your most efficient and productive men turn out better work with high-quality, professionally designed drafting equipment. They will accomplish more, make fewer errors and be far less fatigued when they work with Hamilton professional equipment. Basic Hamilton design gives your engineers or draftsmen new capacity for increased efficiency and improved morale. Our designers will help plan your individual needs.

HAMILTON DELUXE AUTO-SHIFT TABLE This unit combines modern styling with advanced features to create top efficiency. It greatly reduces fatigue, helps your men achieve the highest quality in draftsmanship and maximum production. Fully seasoned drawing surface is adjustable to individual height and slope requirements, providing complete board accessibility that reduces errors. Fast, simple adjustments. Unusually durable and handsome in appearance.

Hamilton Unit System Files
Provide full protection, accessibility, and classification for all materials to be filed. Occupy minimum floor space.

Hamilton L-Contour Table
Prestige-assured, individualized work area providing complete board adjustment plus extra storage and reference area.

Hamilton CL 100 Drafting Table
Conserves dollars, yet rugged canted-leg design provides modern styling and convenience with long-term durability.

Ridgway's LLR

There's a Ridgway's near you.

in **HOUSTON,** Texas
615 Caroline
3800 Greenbriar
Bank of the Southwest Arcade

in **AUSTIN,** Texas
309 W. 10th Street

in **CORPUS CHRISTI,** Texas
516 Lawrence

in **DALLAS,** Texas
933 N. Central Expressway
933 Republic National Bank

in **NEW ORLEANS,** La.
433 Dryades Street

in **SHREVEPORT,** La.
719 Marshall Street
Petroleum Tower Building

in **TULSA,** Okla.
701 S. Cincinnati
5925 East 15th

in **JACKSON,** Miss.
103 East Pearl

in **IRVINGTON,** N. J.
1206-16 Grove Street

in **CHICAGO,** Ill.
10130 Franklin Avenue
Franklin Park

in **DENVER,** Colo.
1522 Glenarm Place

in **LOS ANGELES,** Calif.
590 So. Monterey Pass Road
Monterey Park

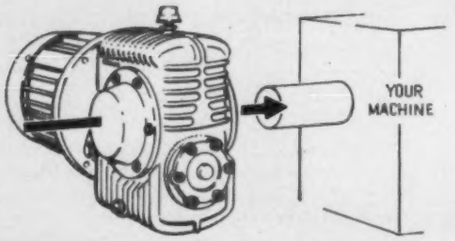
in **NEW YORK,** N. Y.
110 W. 42nd Street
216 E. 49th Street

in **FORT WORTH,** Texas
309 Main Street
3312 Fairfield

Ridgway's Dealers Coast-To-Coast

Circle 114 on Reader-Service Card for more information

CONE-DRIVE GEARMOTORS for "PLUG-IN" POWER



Hollow-Shaft Speed Reducer-Motor forms complete power transmission package . . .

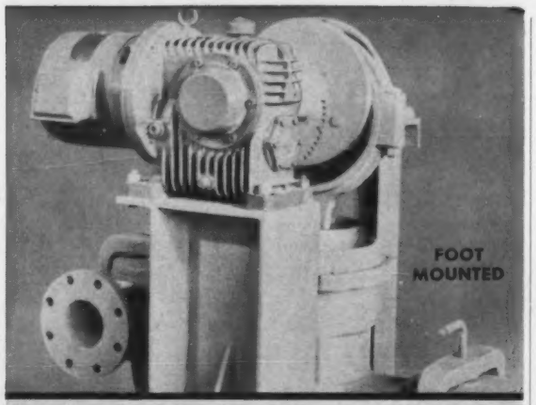
With the compact, right-angle Cone-Drive gearmotor the machine designer can make use of an integral drive package of nearly any required speed and horsepower. Twenty-seven standard output speeds from 7.3 to 525 RPM (with 1750 RPM motor) are available in models from ¼ to 40 horsepower. Gearmotors can be specified with hollow shaft for mounting in any position, ready to "plug-in". You can use this integrated power package to provide a simple, clean installation on your machine . . . no pulleys, belts, sheaves, bed plates, couplings, etc.

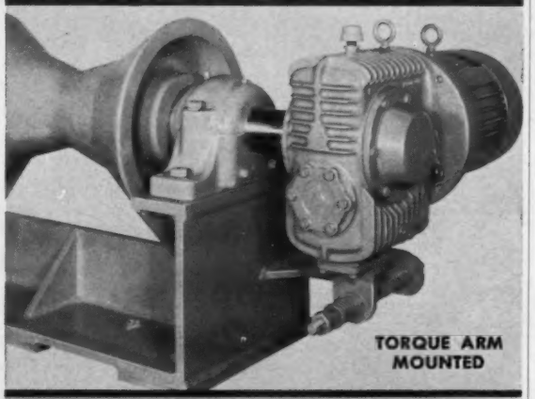
Electric motors are standard "D" flange type with slight shaft modification for driving helical primary reduction gears. Secondary reduction stage is a standard Cone-Drive double-enveloping worm gearset with maximum tooth engagement for greater load carrying capacity in smaller space.

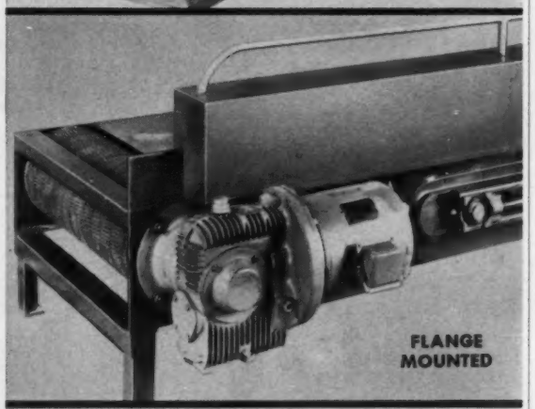
Cone-Drive gearmotors are available for all AGMA service ratings. Call your Cone-Drive representative today or write for catalog #58 for complete specifications.

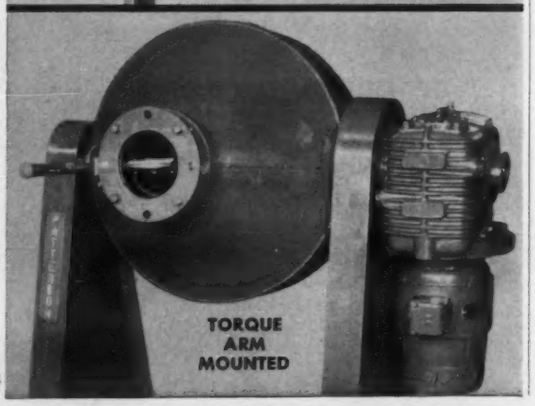
CONE-DRIVE GEARS
DIVISION MICHIGAN TOOL COMPANY
7171 E. McNichols Road Detroit 12, Michigan Telephone: TWinbrook 1-3111

DOUBLE-ENVELOPING WORM GEARSETS
DOUBLE-ENVELOPING WORM GEAR SPEED REDUCERS
DOUBLE REDUCTION WORM GEAR SPEED REDUCERS
DOUBLE-ENVELOPING RIGHT ANGLE GEARMOTORS





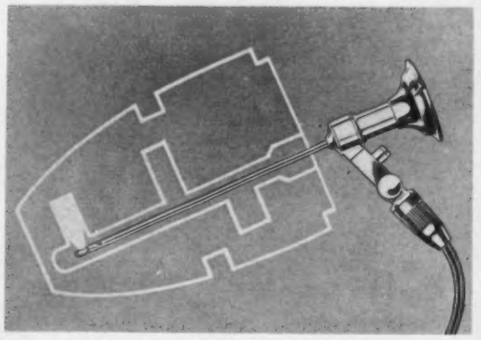




Circle 115 on Reader-Service Card for more information

EQUIPMENT

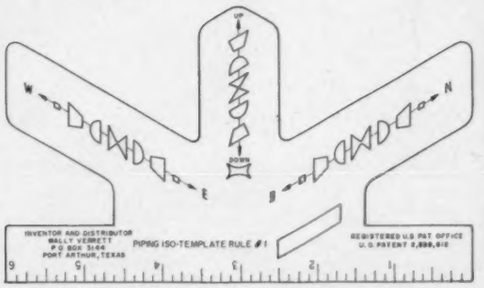
Miniature Bore Scope 368



Complete inspection of very small bores is possible with this scope. A shaft length of 4-11/16 inches and a shaft diameter of 0.145 inch permit this device to be used in situations where other methods of inspection are impossible. Right-angle vision is provided through a lens system of good optical efficiency which produces a magnified image that is clear, corrected and sharply defined. Power is supplied from a battery handle or transformer.

Welch Allyn, Inc., Skaneateles Falls, N. Y.

Isometric Piping Drawing Instrument 369



A template designed for isometric pipe drawings enables standardization to be made of all pipe layout sketches. Features include: pocket size; cut-outs for most common fitting symbols; laminated clear plastic; rounded corners for uniform angles and handy compass orientation points. Engineers, operators, pipe sketchers, detailers, draftsmen and designers will find this tool a welcome addition to their drawing boards.

Wally Verrett, Dept. 8-190, P. O. Box 3144, Port Arthur, Tex.

...and *feel* the difference

You'll discover something new the moment you pick up a DAMASCUS drawing pencil—new comfort, new control. It fits so easily, so naturally in your hand. It means the end of finger fatigue, the beginning of new, positive, non-slip control. You'll enjoy using one. And you'll appreciate the real blackness in every degree that means easy visibility and clear reproduction. You'll also like the smooth, strong lead with the really long-lasting point. Try one yourself and you'll see. In all art and engineering degrees.

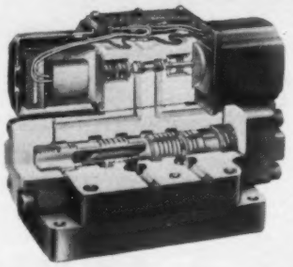
Write for descriptive literature and name of your distributor.

RICHARD BEST PENCIL COMPANY, Inc. DN-1 Springfield, N. J.

Circle 116 on Reader-Service Card for more information

Designer's Fact File from DENISON

HYDRAULIC 4-WAY VALVES



For shockless, hydraulic control on any directional requirement. Pilot-operated, solenoid controlled. Built-in check valve provides pilot pressure without addition of another valve to the system. Has drawn steel solenoid covers secured to body with internal retaining cords. For pressures to 5,000 psi.

Write For Details In Bulletin 240-B.

DENISON ENGINEERING DIVISION
American Brake Shoe Co.
1190 Dublin Road • Columbus 16, Ohio

HYDRAULIC PRESSES
PUMPS • MOTORS • CONTROLS

DENISON HydrOILics

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Circle 117 on Reader-Service Card for more information

UP TO 100 STROKES PER SECOND

THE **DI-PROFILER**

***Flexible Shaft* RECIPROCATING TOOL**

Fast, precise, free from vibration, the Di-Profiler is indispensable for die, tool and mold making and finishing. The controlled stroke is variable from 0 to ¼" and the speed is adjustable from 0 to 100 strokes per second. Impact of stroke is spring cushioned to reduce possible damage to work, tool or Di-Profiler.

Moderate in cost, the Di-Profiler pays for itself quickly through man-hours saved. Accessories for every type of job make this tool quickly adaptable for working any contour, detail, or finish.

Ask for a free demonstration or Catalog Sheet DB-31.

HYPREZ DIVISION
ENGIS EQUIPMENT COMPANY
431 South Dearborn Street, Chicago 5, Ill.

Circle 118 on Reader-Service Card for more information

You needn't be a **SHERLOCK**

to discover the advantages in using CARR-LANE'S

BALL PINS

they stay-put

The BEST yet!

In seven diameters and any grip length. Won't fall out of the hole even if upside down. Pin diameter accurately ground to + .0000 − .0015 can be supplied with 14" nylon covered cable that won't kink like chain. All this and they sta-put too.

Rust Proof black oxide finish per (mil. spec.-C-13924A) alloy steel with single shear strength 4000 to 65000 lbs. depending on size

● Just another one of the quality items from CARR LANE — send for Catalog today!

Carr Lane MANUFACTURING CO.
4200 Krause Court
St. Louis 19, Mo.

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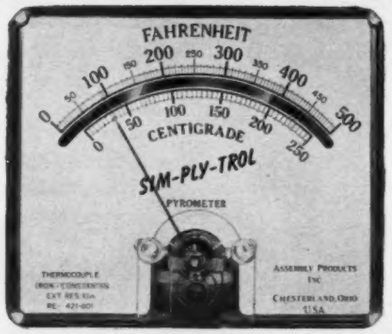


A. P. I. INDICATING PYROMETERS

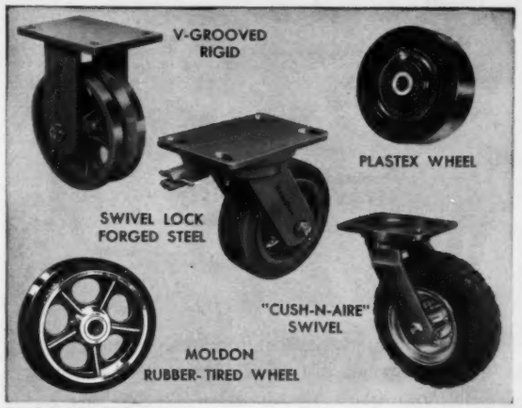
are medium-resistance D'Arsonval meters with automatic, bimetal, cold-junction compensation, and copper-error correction. Standard accuracy is ± 2% (but ± 1% is available if you need it). Also standard are such niceties as an external 10-ohm resistor (to compensate for thermocouple resistance) that is adjustable, and mirror scales that avoid parallax reading errors. A.P.I. makes indicating pyrometers in 10 standard ranges (—200 to 3000°F.); 3 case types (clear plastic, black bakelite, ruggedized-sealed); and 6 sizes (2½" to 6"). All are surprisingly inexpensive. You'll have little trouble finding one that will fit your exact requirements for low-cost, accurate temperature indication.

Write for Bulletin 107

api **ASSEMBLY PRODUCTS, INC.**
CHESTERLAND 18, OHIO

S.A. 2236

Circle 120 on Reader-Service Card for more information



HAMILTON—the complete line... the quality line

INDUSTRIAL CASTERS and WHEELS

When you need casters and wheels, specify the Hamilton line- one of the world's most complete selections of sizes, styles and capacities. Get Hamilton quality, performance, service—at low competitive prices. Send today for Hamilton's Caster and Wheel Catalog, and name of nearest Hamilton distributor.

Please send me a Hamilton Caster and Wheel Catalog

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COMPANY.....

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CITY..... ZONE..... STATE.....

THE HAMILTON CASTER & MFG. CO., 1802 Dixie Hwy., Hamilton, Ohio

Circle 121 on Reader-Service Card for more information

Metric-English Conversion Calculator 370

One side of this calculator lists decimal equivalents of millimeters from 0.01 to 100 mm. Also shown are Centigrade-Fahrenheit temperature conversions from —459.40 to 1790 deg. The other side provides Centigrade-Fahrenheit conversions from 1800 to 3000 deg. Also shown are decimal and metric equivalents, parts of an inch in 1/64-inch increments from 1/64 to 1 inch. In addition, 59 simple formulas are shown for converting a variety of metric factors into British equivalents. Calculator is 3⅝ by 8½ inches.

Kelm Mfg. Co., Route 2, Coloma, Mich.

It is noteworthy that more and more McGill bearing users are those who have revised their specifications on existing products to include McGill bearing design and performance advantages. Perhaps you have just switched to McGill — to the GUIDEROL series or to the new CAGEROL cage type needle roller bearing. Wouldn't it logically follow that you could be served even better by matching the best product and bearing design capabilities in the early development stage. Here McGill engineers can offer their experience with thousands of successful applications when it can be most easily applied to your new designs and your plans for increased product performance. It would offer further time and cost advantages. Most important, it is your best assurance that our extensive bearing research will complement your long range product development more specifically. Ask for McGill recommendations so that details can be worked out together.

1960*
in today's specifications

McGILL® BEARINGS

in tomorrow's product development
1970?

Write for McGill Brochure No. 660, a bulletin of facilities and abilities. It explains how we can help you on your bearing application problems in the early stages of product research and development.

FOR EXTRA LOAD CAPACITY
IN MINIMUM
RADIAL SPACE
use

McGILL®

GUIDEROL® BEARINGS

MT SERIES

Here is a compact bearing with high load-carrying capacity. Its full complement of race-width rollers is guided by an integral rail in the outer race bore, providing strength and skewing limitation that prevents binding under controlled misalignment. Rollers are guided at any operational angle from horizontal to vertical — self-cleaning through open ends. Available with or without separate inner ring in shaft sizes from ½" to 9¼". Dimensionally interchangeable with ordinary heavy duty needle bearings.

CT SERIES

Offer full type roller bearing capacity dimensionally interchangeable with ball and cylinder roller bearings of single and double row dimensions. The inner ring may be eliminated for further reduction of radial space.

SEALED—AND STILL COMPACT

No extra axial space needed for the sealed SG series GUIDEROL bearing. Seals are press-fitted securely in the outer race bore to provide the same width and performance advantages of standard GUIDEROL bearings. Contaminants are locked out, lubricants sealed in for those hard to re-lubricate applications. The SG series solves the problem of too-expensive auxiliary sealing assemblies.

Write for McGill's Bearing Catalog #52-A, for engineering data with dimensional and capacity information on McGill needle type roller bearings. Ask about special precision ball and roller bearings.

McGILL MANUFACTURING CO., INC., Bearing Division
203 N. Lafayette Street, Valparaiso, Indiana

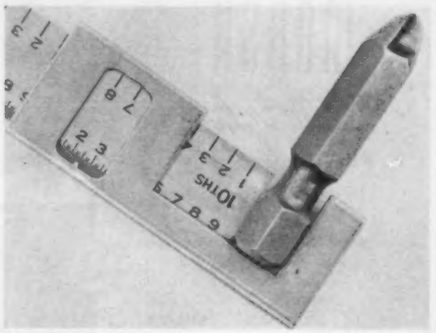
engineered electrical products

McGILL®

precision needle roller bearings

Circle 122 on Reader-Service Card for more information

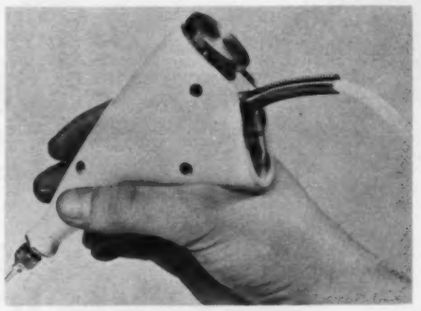
Micrometer Scale Attachment 371



The "Micro Slide" fits standard 6-inch scale, converting it to a micrometer. Machinists, aircraft assemblers, tool makers and mechanics who use a 6-inch scale will find the attachment invaluable as a fast, precision-measuring tool. It can be attached to scale and easily carried in shirt pocket. Unit will in no way impair scale for its standard use, and is an inexpensive tool.

G. W. Gregory, 68 Casselman Pl., Chula Vista, Calif.

Electric Engraver 372



Permanent identification of tools, machinery and production parts is quickly provided with the electric "Vibro-Graver". Carbide point writes names, initials or code numbers at a speed of 7200 vibrations a minute. Portable and easy to use as a pencil, the unit is encased in unbreakable polypropylene with a comfortable handrest design. A control wheel adjusts for fine, medium or coarse stroke on metals, marble, tile, glass, plastics, leather, ceramics and hard rubber. This tool may be used for marking laboratory equipment, slides, machinery, parts, materials, models, maintenance supplies, storm windows, screens or personal property.

Burgess Vibrocrafters, Inc., Commercial Products Div., Grayslake, Ill.

THREE SERIES

MARSH

Needle Valves

for every service

ALLOY STEEL

316 STAINLESS STEEL

416 STAINLESS STEEL

Now—with the addition of a 316 stainless steel series—you have a Marsh Needle Valve for almost any purpose or service. Full range of sizes and patterns. Wide range of pressures and temperatures. All are machined from solid bar stock. All have precision ground stems for close regulation—tight shut-off. All have "Marpak" moulded packing; Teflon in stainless steel valves.

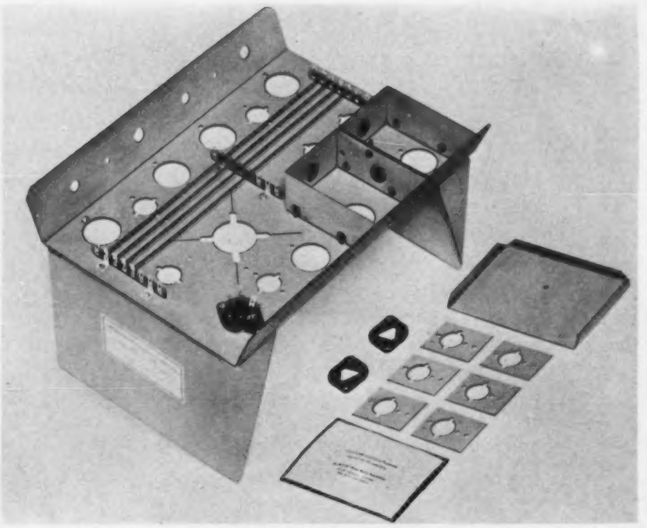
Ask for bulletins covering full line.

MARSH INSTRUMENT COMPANY
Dept. 38, Skokie, Ill.
Division of Colorado Oil and Gas Corporation

Marsh Instrument & Valve Co. (Canada) Ltd., 6307 103rd St., Edmonton, Alberta, Canada. Houston Branch Plant 1121 Rockwell St., Sect. 15, Houston, Texas. Eastern Seaboard Warehouse: Marsh Instrument Company, 1209 Anderson Ave., Fort Lee, N.J.

Circle 123 on Reader-Service Card for more information

Prototype Chassis 373



Designed to enable engineers to build prototypes and design new circuits without delay of waiting for fabrication of a special chassis, these units achieve the dual advantage of economy and versatility. The designers' chassis are constructed of heavy-gage aluminum alloy and may be collapsed for compact storage. Experimental circuits can be "filed away" for future reference. Holes are provided for mounting standardized electronic components. Units come complete with adapter plates for converting octal socket mountings to 7 or 9-pin miniature sockets. Model 14B, with unitized construction, embodies an advanced concept of breadboarding. Mountings for 14 electronic tubes in any combination of octal or 7 or 9-pin sockets are provided by means of a highly flexible hole pattern. Model 24 provides mounting holes for 24, 7 or 9 miniature tubes, including 10 octal-socket mountings for more complex circuitry. A special model, 8B, is also available, for mounting subminiature components, providing 16 transistor sockets plus a grid pattern of 140 holes.

Wittek Products Co., 14750 Keswick St., Van Nuys, Calif.

ROD END INTERNAL THREAD TYPE "DREF" SERIES

"Dyflon"®

Self-Aligning and Self-Lubricating

SPHERICAL BEARINGS

ROD END EXTERNAL THREAD TYPE "DREM" SERIES

Combine "Monoball"® Engineering Advantages with Life-Time Lubrication

Design engineers in many industries are specifying new "DYFLON"® SELF-ALIGNING and SELF-LUBRICATING SPHERICAL BEARINGS for these 5 major reasons:

1. LOWER COEFFICIENT OF FRICTION
...ideal where lubrication is impossible or undesirable.

2. WITHSTAND EXTREME VIBRATION
...perfect performance under shock load conditions.

3. WILL NOT "COLD-FLOW"
...even under extreme load conditions.

4. IMPERVIOUS TO KNOWN CHEMICAL SOLVENTS
...eliminates corrosion problems.

5. FAIL-SAFE ...due to "Monoball"® design.

Request Engineering manual No. 551.

In addition, due to their two-piece "MONOBALL"® design and plastic alloy insert, "DYFLON"® bearings have a long cycle life. Alignment and installation problems are minimized. Oil-free for life means lowest possible maintenance costs.

Available in a variety of plain or rod end types. Bore sizes to 3.000". Materials include stainless steel, plastic alloys and chrome alloy steels. Ultimate static loads to 500,000 lbs.

SOUTHWEST PRODUCTS CO. 1705 SO. MOUNTAIN AVE. MONROVIA, CALIF. • PHONE: MURRAY 1-9616

Circle 124 on Reader-Service Card for more information

look to these **PARA-TONE** products to add a new dimension to your design jobs:

Zip-A-Line Tapes
Zip-A-Line Tape Pen
Copy-Zip
Para-Paque
Para-Tipe
Para-Tone Numbers
Symbols
Arrows
Lines
Templets
Grid Sheets

see them at your dealer, or write us for catalogs.

PARA-TONE Incorporated

512 W. Burlington Ave., LaGrange, Ill.

Circle 125 on Reader-Service Card for more information

Self-Inking Stamps 374

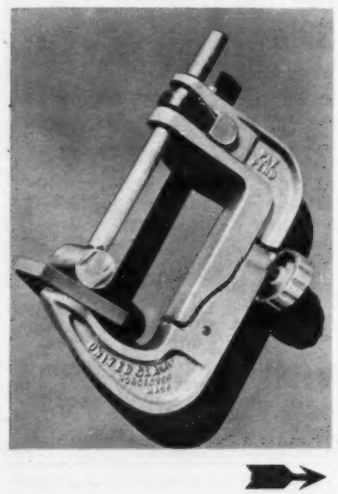
Self-inkers contain no small, breakable parts, resulting in greater marking efficiency and longer life. They offer a lock position, preventing marking die from resting on pad. Stamps require no oiling and are available in the following sizes (size of printing surface) with any copy, trademark or design: 2 by ⅝, 2¼ by ⅞, 1¾ by 1 and 2½ by 2 inches.

Krengel Mfg. Co., Inc., 227 Fulton St., New York 7, N. Y.

C-Clamp 375

This finger-tip-control, threadless clamp provides a "third hand" for users. Clamping device, made of high-tensile-strength aluminum alloy, finds wide application of use in machine, sheet metal, plumbing and woodworking shops, in garage and repair shops, and in tool and maintenance departments. The clamp is quick closing and opening. Threadless spindle eliminates frame twisting from tightening. Anvil and spindle do not turn while pressure is being applied, and as a result, materials held are free from clamp marks. Clamp can be furnished with either anvil or V-spindle and is available in 2, 4 and 6-inch sizes.

United Associates, 1605 N. Hercules Ave., Clearwater, Fla.



Circle 126 on Reader-Service Card

ENGINEERING NEWS-#2

HERMETICALLY-SEALED SWITCHES

CHECKED | ENGR. | CONTROL SWITCH DIVISION

H11-2 (conforms to MS 24331-1)

actual size

Model H11-2, like all Control Switch hermetic switches, is completely sealed against all contaminants, atmospheric and altitude conditions. Units are backfilled with a dry, inert gas, and inspected with a mass-spectrometer to a leak rate of less than one micron cubic foot per hour at one atmosphere.

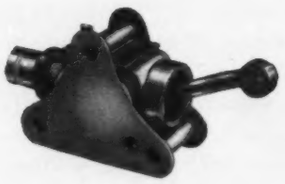
H11-2 contains two basic SPDT switches with 6 terminals for multi-circuit control (Conforms to MS 25085.) This Model is available with a variety of actuators (plungers, roller plunger, rotary arms), termination (wire leads, cable, pigmy or standard connector receptacles) in a standard 1-inch diameter housing.

H11-2 OPERATING CHARACTERISTICS

Contact Arrangement	2—S.P.D.T.
Pretravel	.040 Max.
Movement Differential	.020 Max.
Overtravel	.250 Min.
Operating Cycles	25,000 Min.
Break Distance	.010 Min.
Difference of Operating & Reset Pt. Between Each Pole	.010 Max.
Operating Force	9 ± 3 lbs.
Overtravel Force	30 lbs. Max.
Release Force	4 lbs. Min.
Electrical Rating— Sea Level to 100,000 Ft.	28 VDC, 4A Res. 2 A. Ind.—4A Motor
Lamp Load @ 28 VDC	2.4 amps
Ambient Temperature Range	—100° to +221°F
Weight	2¾ Oz. Approx. W/out leads

All units in the H11-series mount through a single hole, and are infinitely adjustable by use of lock nuts. Other H11-series models are available with Single Pole, 3-Pole and 4-Pole circuits, and unlimited variety in physical and operating characteristics. All have exposed parts of Stainless Steel or Monel, or are treated for corrosion resistance. Heliarc welding is used for positive sealing. Headers are brazed, not soldered.

H1-8, half-size



H6-89, half-size

H10-48, half-size

H1-series: Roller-lever actuation, mounted by 3-tube or backing plate methods. S.P.D.T. or D.P.D.T.; N.O. or N.C.; 2 or 4 circuits available. Rated 10 amps @ 125/250 VAC. Conforms to MS 25040.

H6-series: Ball bearing roller arm actuator. Side plate or "poke-thru" mounting. High shock resistance S.P.D.T. or D.P.D.T. Conforms to all Military aircraft specifications.

H10-series: Rigid, adjustable or roller arm rotary actuation. D.P.D.T., 10 amp rating with MIL approved simultaneous action. MS 25040 type construction.

CONTROLS COMPANY OF AMERICA
CONTROL SWITCH DIVISION
1418 Delmar Drive • Folcroft, Pennsylvania
TELEPHONE LUdlow 3-2100 • TWX SHRN-H-502

Manufacturers of a full line of switches, controls and indicators for all military and commercial applications. All standard units stocked for immediate delivery by leading parts Distributors.

Visit I.R.E. SHOW • Mar. 20-23, 1961
BOOTH 1727-1731

ENGINEERING NEWS -- Hermetically-Sealed Switches

You can put
½ TON
on this slide

New Heavy-Duty Slide from Chassis-Trak

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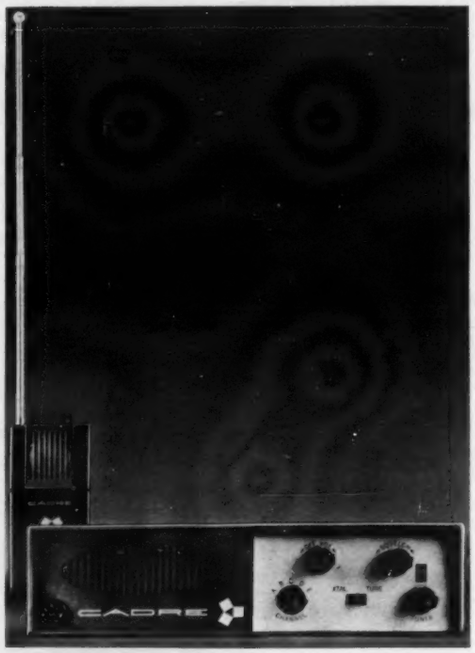
EQUIPMENT

Citizens Band Transceiver 376

This is a 5w portable transceiver, designated model 500, incorporating 15 transistors and 7 diodes. Its low power drain of only 2w makes it useful for mobile as well as fixed operations. Transmitter provides maximum efficiency and has a power input of 5w, 100-percent modulation capability and high frequency stability of 0.005 percent. Transceiver operates on 5 crystal-controlled transmit-and-receive channels; receiver is also tunable to all 22 channels. It has front-panel squelch and an automatic noise limiter. Power requirement is either 115v a-c supply or standard 12v battery.



The companion, model 100, a 100-mw transceiver, produces a clean stable signal (within 0.005 percent) over a ½ to 1-mile range. Operating on one crystal-controlled transmit/receive channel, it will provide good reception on any chosen one of the 23 CB channels. Incorporating 7 transistors and 1 diode, unit measures only 6¼ by 2¾ by 1½ inches, and weighs only 20 oz. Power is supplied by a standard 12v mercury battery.

Cadré Industries Corp., Endicott, N. Y.

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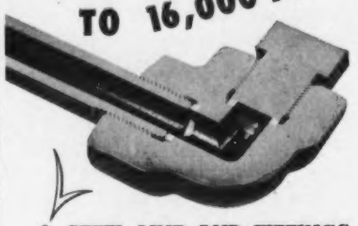

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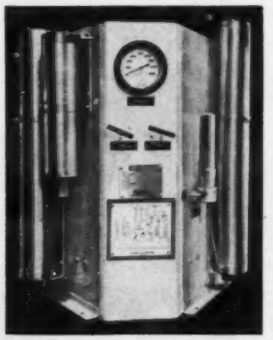

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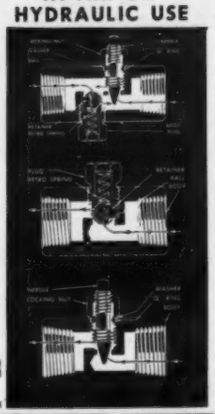

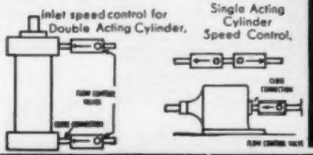

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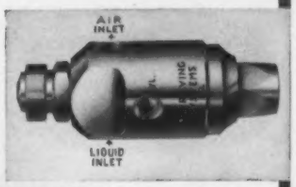

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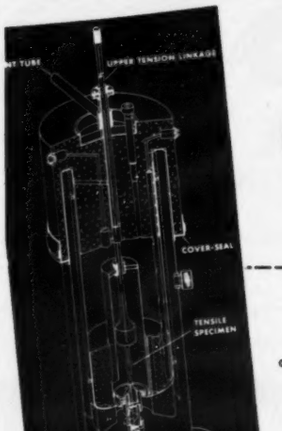

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Ceramic Switch Arms Missile for Stage Separation

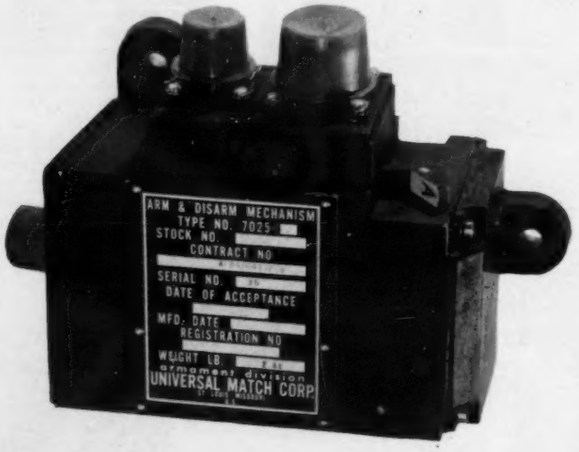
Lars G. Soderholm, Midwest Editor

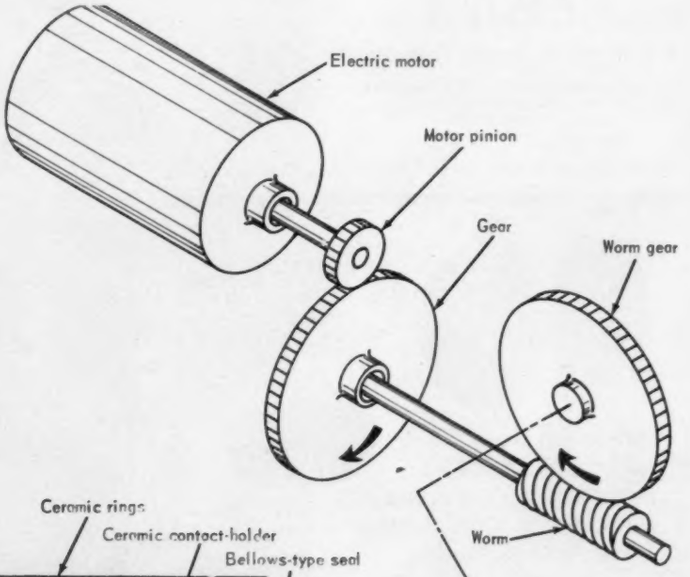
An especially constructed, hermetically sealed ceramic switch was designed for high reliability and resistance to conditions encountered on a trip through space. It is found in the arm-disarm mechanism for a missile stage-separation unit. Switching is performed remotely through a motor-driven locking cam.

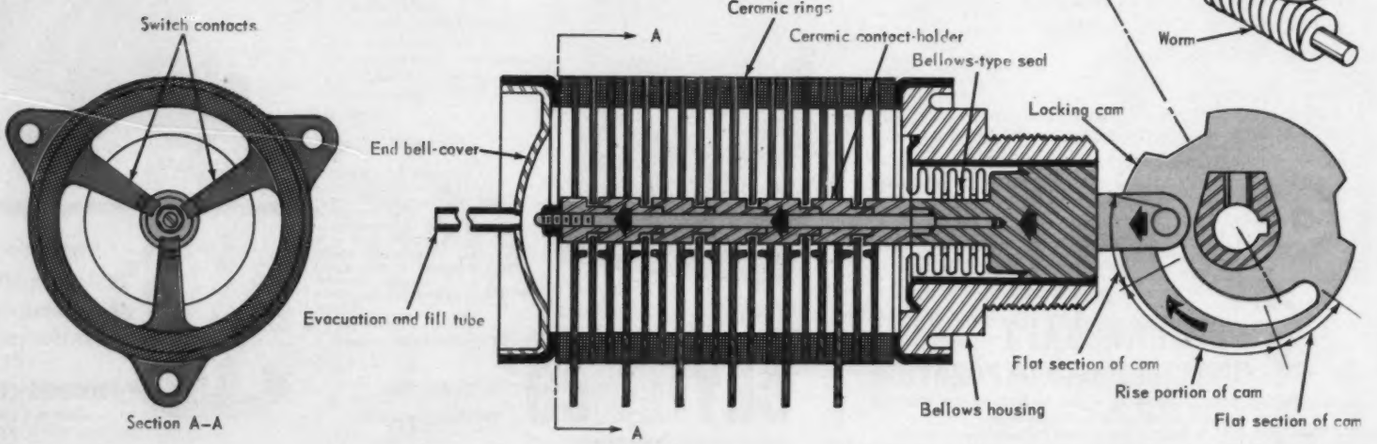
Meeting military requirements often forces a designer to come up with different concepts. Some of the interesting design work necessary to develop a switch meeting missile requirements is apparent in the ceramic switch used in this arm-disarm mechanism.

The contacts of the switch are made of molybdenum because of this material's high stiffness-to-mass ratio. For reliability, each contact has three prongs shaped as a tapered cantilever beam. This design places the resonant frequencies over 3000 cycles per second. In addition, the molybdenum contacts can handle heavy currents without wear or arcing. This material also retains its hardness at temperatures far higher than the 600F design temperature of the switch.

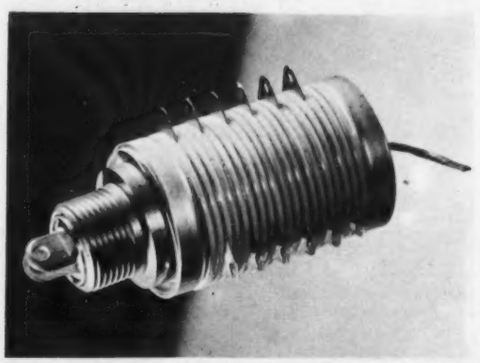
All molybdenum contacts of the switch are sand-







LOCKING CAM is machined to retain pin in movable center section of ceramic switch. Ninety-deg movement moves switch into required contact position. Twenty-five deg flat radius at each end of cam locks switch into either arm or disarm position. For missile applications, atmospheric pressure changes cannot change switch setting. Also, mounting is such that internal pressure at high altitudes and acceleration of rocket motors tend to hold switch in arm position.



wiched between metallized ceramic rings whose outer surface is glazed. These alumina rings are brazed to the molybdenum contacts to provide a tight, strong bond between the two materials. The end bell and bellows housings located at each end of the ceramic ring stack are made of Westinghouse Electric Corp.'s alloy, "Kovar." This nickel-iron-cobalt alloy matches the coefficient of expansion of the ceramic rings.

The movable switch center terminal is sealed by brass bellows. A tube attached to the end bell permits evacuation of the switch and filling with a gas mixture of 90 percent sulphur hexafluoride and 10 percent helium. Helium acts as a leak detector trace. This inert gas has high dielectric strength to prevent arcing between the unused and center terminals. The switch is filled to atmospheric pressure and then is sealed.

In the missile arm-disarm application, the ceramic switch is used as a six-throw, double-pole switch. Each circuit can handle 6.5 amps at 28v.

The stage-separation unit is armed remotely before firing. After the missile is removed from storage, a safety pin first is removed. Prior to firing, the remote arm button is pressed and an electric motor, through a gear train, turns a locking cam to throw the switch into the armed position. The actual arming takes only a fraction of a second and power is on for only a short time. If needed, the stage-separation unit can be disarmed in the same manner from a remote button. Once the missile is launched, the switch has to resist high temperatures, vibration, acceleration and vacuum encountered in space. Finally, a current pulse from the guidance and control system sent through the arm-disarm mechanism activates the unit, which separates one stage of the missile. Multiple stages can be separated in this manner, using either single or multiple arm-disarm mechanisms.

Developed by Universal Match Corp.'s Armament Div., St. Louis, Mo., the hermetically sealed ceramic switch is available commercially with any number of circuits and can be furnished as a single-throw or double-throw unit.

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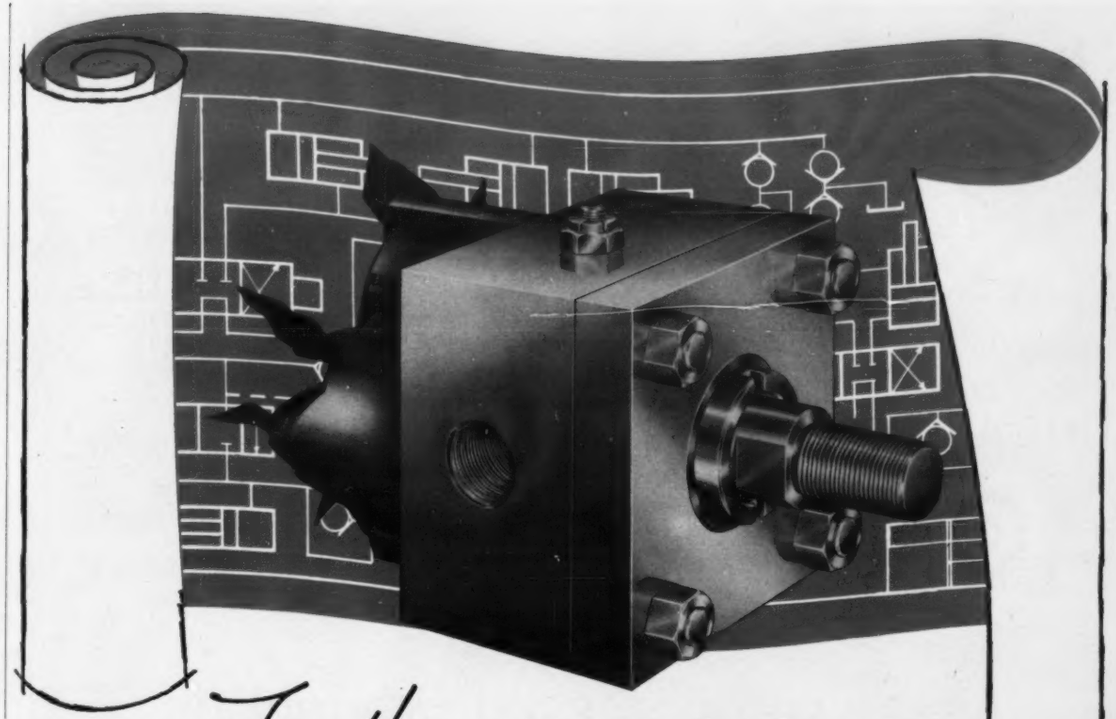

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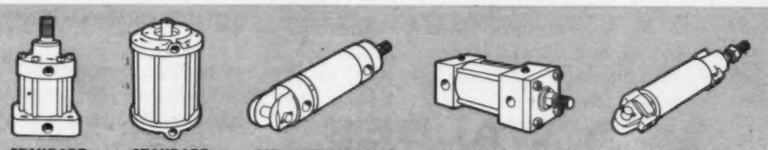

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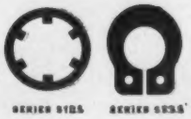
Truarc self-locking rings  replace other fasteners . . . eliminate tapping of casting on this tiny tape recorder. Result: MOHAWK BUSINESS MACHINES CORP. increased production 60% and sharply reduced assembly costs.

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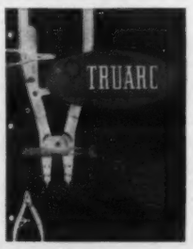

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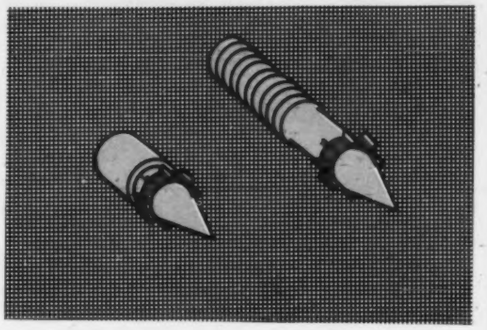
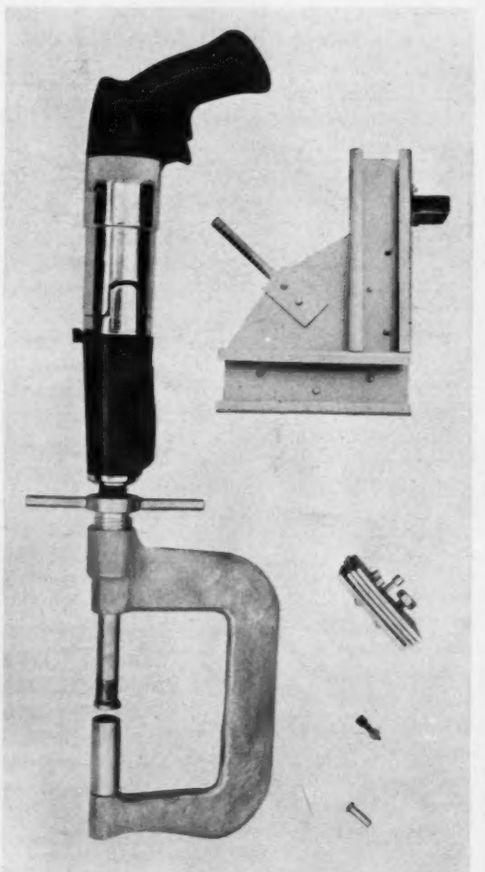
Plastic Extrusion Guides Steel

Edward W. Schrader, Western Editor





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Pellet in Powder-Actuated Riveter

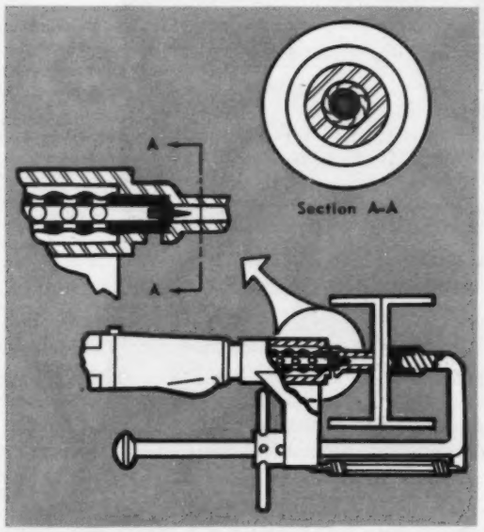
A flexible plastic sleeve fits over the projectile in a hand rivet gun. The folded fins, when the projectile is inserted into the gun, serve as lands in the smooth barrel. The plastic sleeve is stretched over the projectile. It also serves as a gas seal for propulsion within the gun.

The hardened steel projectile has the strength to penetrate steel plate. It also has the toughness to form a head. Its tensile strength is more than 210,000 psi and its shear strength is more than 106,000 psi. Standard-sized pin for riveting thin steel plate is ¼-inch head dia and 0.180-inch dia shank.

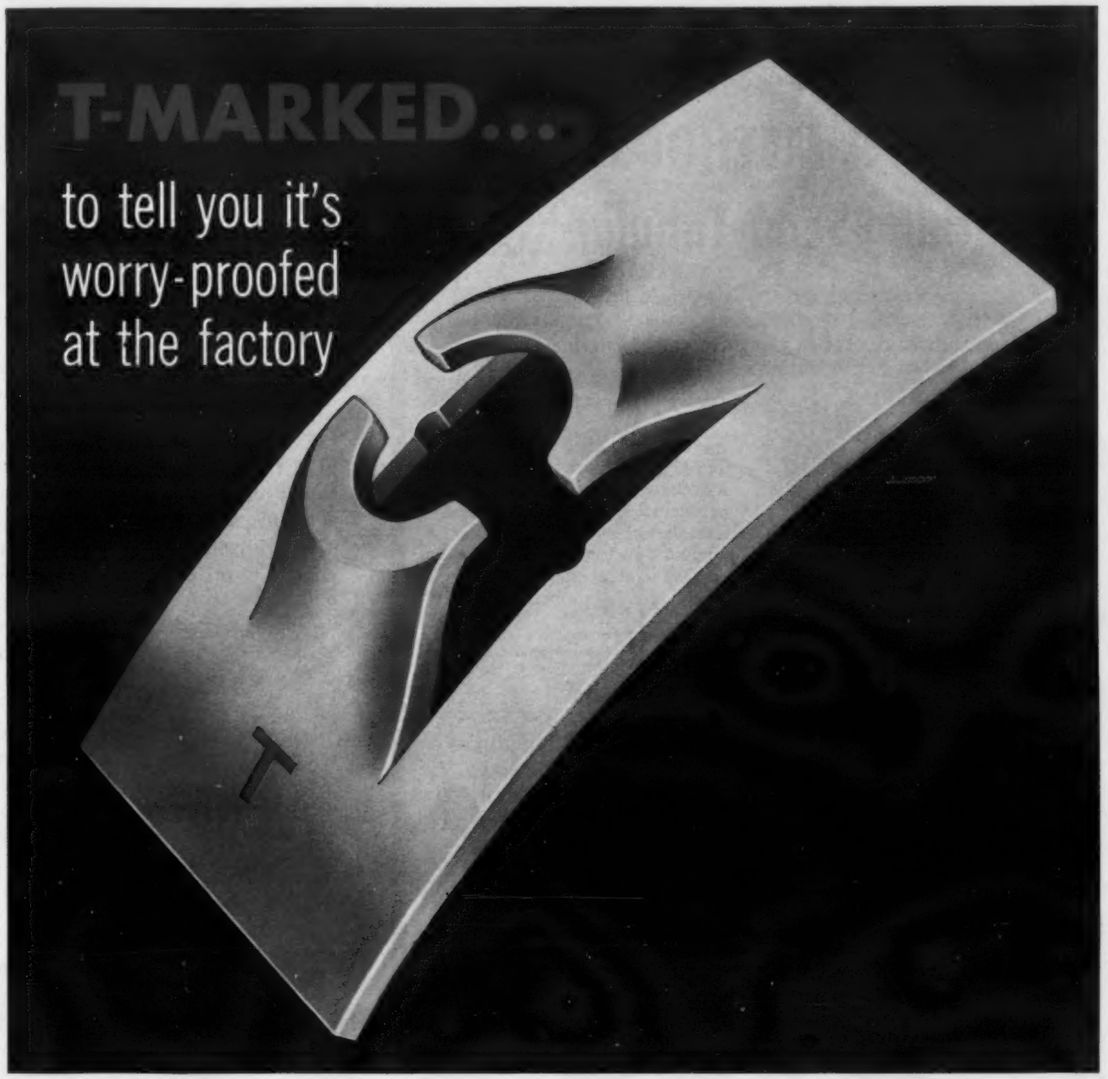
In a riveting operation, steel plates are placed between the muzzle end of the riveter and the die. The C-shaped clamp and screw automatically bring the die and the muzzle into the proper location for riveting. For rivet penetration, the muzzle must be held firmly against the plates.

To load, the tool snaps open at the breach. The previous cartridge is ejected automatically. The ¼-inch drive pin is positioned in the barrel, and a 0.25-caliber cartridge is inserted behind the rivet.

The Model 330 Powder-Actuated Tool is imported from Japan Drive-It Co., Ltd., and is marketed exclusively in the U. S. by Superweld Corp., North Hollywood, Calif.



MUZZLE SECTION shows barrel aligned with forming die clamped around steel plates.



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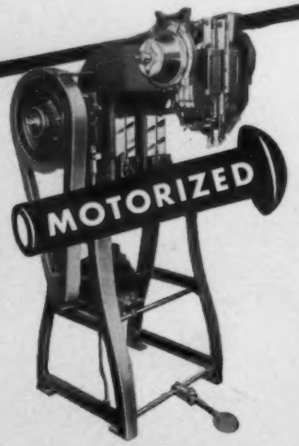
Why *Chicago Rivet* Offers TWO METHODS for Clinching Semi-Tubular Rivets

It is part of a widening service based upon industry's recognition that an assembly held together by semi-tubular rivets has great inherent strength and is usually lowest in production cost.



The Chicago Rivet MOTORIZED AUTOMATIC RIVET SETTER produces a sharp, solid blow that immediately upsets the tubular section. This method is used on 95% of all applications involving metals or non-fragile materials.

The Chicago Rivet AIRPOWERED RIVETER produces a cushioned, shock-free clinch on a tubular rivet, permitting riveting of fragile and uneven materials. This method has greatly widened the use of semi-tubular rivets.

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Why not let Chicago Rivet Fastening Engineers tell you which system is best for you. No obligation.

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Resuscitator Requires Variety of Rubber

E. J. Stefanides, Central States Editor

The design of a new device for use in the professional and industrial administering of artificial respiration presented significant problems in material selection. It was important to obtain the desired operating characteristics at the minimum cost.

The device itself was designed to accomplish two specific objectives: (1) to provide a device which eliminates the obvious hygienic objections to the mouth-to-mouth method of artificial respiration and (2) to provide a modification of the mouth-to-mouth method which increases its efficiency and eliminates the physical hazards to both operator and patient.

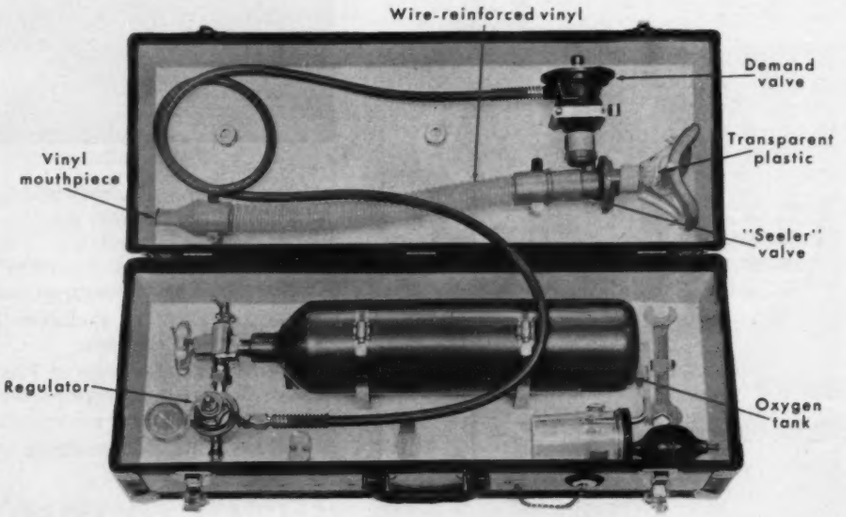
The first requirement was met by using a face mask attached to the Seeler M/M valve and equipped with an extension breather hose and mouth-piece for the operator. This not only eliminates the objectionable mouth contact, but also provides a valving action which vents the patient's exhalation.

The chief danger to the patient, over-inflation of the lungs, is eliminated by a spring-loaded relief valve. This valve is set to open at a pressure of 24 mm of mercury (13 inches of water).

Hyperventilation of the operator is eliminated by a rebreathing system which maintains the operator's carbon-dioxide balance. The rebreathing system is based on mixing a fixed volume, (approximately 300 cc) of the operator's exhaled air with the fresh incoming air. The high carbon-dioxide content of this used air prevents lowering of the carbon-dioxide content of the operator's blood stream. This system also causes the first 300 cc of the flow entering the patient's lungs to be fresh unused air with its full normal content of 21 percent oxygen.

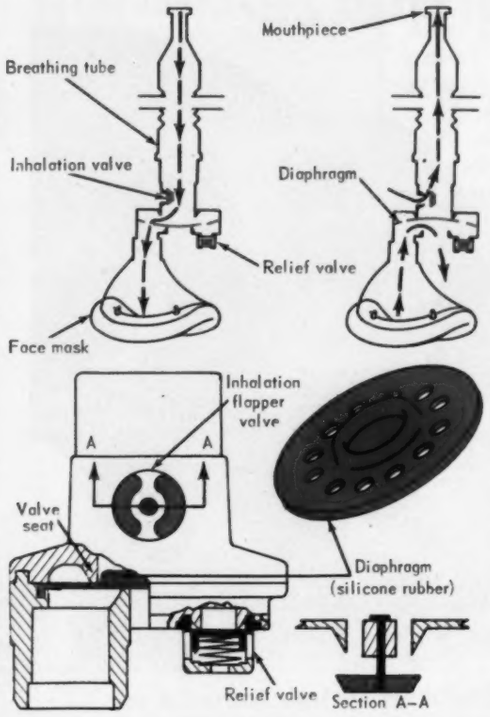
The resuscitation mask kit is supplied with the usual aspirator, catheter and airway accessories. It also can be supplied with an oxygen tank and demand valve for administration of oxygen.

The materials used in this device include several different rubber compounds



RESUSCITATOR valve body parts, relief valve and mouthpiece insert are molded of high-impact, high temperature polystyrene for rigidity and strength. Mask is surrounded by neoprene latex cushion filled with sponge rubber. Sponge makes cushion self-inflating when auxiliary valve is opened. Relief valve spring is stainless steel.

and Plastic Materials



SEELER M/M VALVE ACTION. As operator exhales, valve diaphragm moves down to close exhaust vent and open passage to face mask. Diaphragm is about 0.010 inch thick and is perforated to reduce flow resistance. When operator inhales, valve diaphragm moves up and closes passage from patient to breathing tube and operator. Fresh air for operator enters through inhalation valve and mixes with 300 cc of operator's exhaled air in breathing tube (high in carbon-dioxide). Relief valve opens at 24 mm mercury pressure, preventing overinflation of patient's lungs.

and a number of different plastics. Besides the special properties required of the individual parts, all the details were required to be of rugged construction and capable of resisting corrosion under normal operating and storage conditions.

The configuration of the M/M valve was conceived by Henry W. Seeler of the Aero Medical Laboratory of Wright Patterson AFB, Ohio. The commercial model was designed and is manufactured by the Medical and Hospital Dept. of Globe Industries, Inc., Dayton, Ohio.

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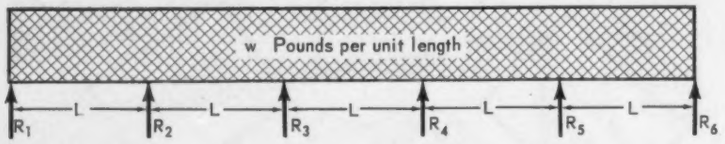
DESIGN DATA NEWS

Shear and Moment Coefficients for Continuous Beams

S. Warren Kaye, Raytheon Co., Bedford, Mass.



Bending moment at any point along a beam or shaft supported at more than two points and subjected to uniform loading is usually difficult to determine.

This article presents an illustrative diagram showing values of shear and moment coefficients for a continuous beam of equal spans subjected to uniform loading for beams up to five equal spans. The illustrative problem shown below makes use of the three moment equation and derives shear and moment coefficients for the five equal span condition.

Problem:

Draw the shear and moment diagrams for a continuous beam of five spans each of length L, subjected to a load w per unit length over the entire beam. Also find maximum fiber unit stress.

Solution:

(a) By use of the theorem of three moments, find the negative bending moment over all supports.

(b) Find the reactions of the supports from the negative moments over the supports. All external forces acting on the beam then will be known.

(c) Find the vertical shears at various sections, and draw the shear diagram.

(d) Find the bending moments at various sections, and draw the moment diagram.

The empirical formula for the three moment equation reduces to:

$$M_1 + 4M_2 + M_3 = -1/2\ wL^2$$

In accordance with the theorem of three moments, the following equations may be written:

Solution Part (a):

(1) $M_1 + 4M_2 + M_3 = -1/2\ wL^2$
(2) $M_2 + 4M_3 + M_4 = -1/2\ wL^2$
(3) $M_3 + 4M_4 + M_5 = -1/2\ wL^2$
(4) $M_4 + 4M_5 + M_6 = -1/2\ wL^2$

Because there are no end restraints, $M_1 = M_6 = 0$, and by symmetry, $M_2 = M_5$ and $M_3 = M_4$. Combining Equations (1) and (2) and substituting from conditions leads to Equations (5) and (6).

(5) $0 + 4M_2 + M_3 = -1/2\ wL^2$
(6) $M_2 + 5M_3 = -\frac{1}{2}\ wL^2$

Multiply (6) by 4

Equation (6) now becomes:

$$4M_2 + 20M_3 = -2\ wL^2$$

Subtract (6) from (5)

(5) $4M_2 + M_3 = -1/2\ wL^2$
(6) $-4M_2 - 20M_3 = +2\ wL^2$

$$-19M_3 = 3/2\ wL^2$$
$$M_3 = -3/38 wL^2 = M_4$$

Substituting in (5) and solving for M_2

$$4M_2 = -1/2\ wL^2 - M_3$$
$$= (-1/2 - (-3/38))\ wL^2$$
$$= ((-19 + 3)/38)\ wL^2$$
$$M_2 = ((-16/38)/4)\ wL^2$$
$$= -2/19\ wL^2 = M_5$$

$\therefore$ $M_1 = M_6 = 0$
$M_2 = M_5 = -2/19\ wL^2$, and
$M_3 = M_4 = -3/38\ wL^2$

Solution Part (b):

The bending moment M_2 at a section over the second support R_2 was found to be equal to $-2/19\ wL^2$, but the bending moment at any section is the algebraic sum of the moments of the forces to the left of that section. Therefore:

$$(R_1)\ (L) - wL\,(L/2) = -2/19\ wL^2$$

Solving for R_1

$$R_1 = (-2/19 + 1/2)\ wL = +15/38\ wL$$
$$= R_6 \text{ by symmetry.}$$

Similarly solving for R_2

$$R_2 = (-3/38 - 30/38 + 76/38)\ wL$$
$$= +43/38\ wL$$
$$= R_5 \text{ by symmetry.}$$

Similarly solving for R_3

$$R_3 + R_4 = (15/38 + 43/38)(2) = 5\ wL$$
$$R_3 + R_4 = ((190-116)/38)wL = 74/38\ wL$$

Since $R_3 = R_4$

Then $R_3 = R_4 = +37/38\ wL$

$\therefore$ $R_1 = R_6 = +15/38\ wL$,

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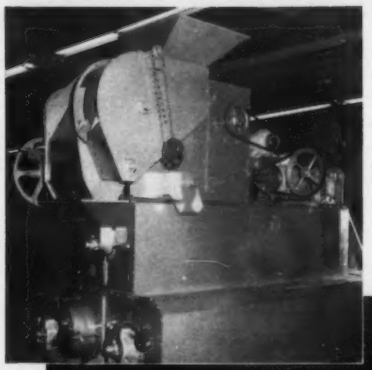
Why Lovejoy Vari-Speed Equipment Drives This Precision Processing Machine



Known as the "Dominion Minor", this grain processing machine* is a multi-cylinder unit which scalps, aspirates and makes five clean cut separations on all types of grain.

Lovejoy Vari-Speed components used are:

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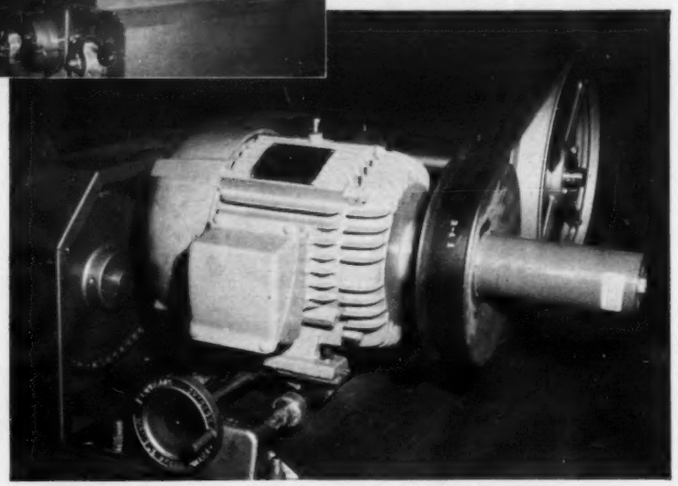

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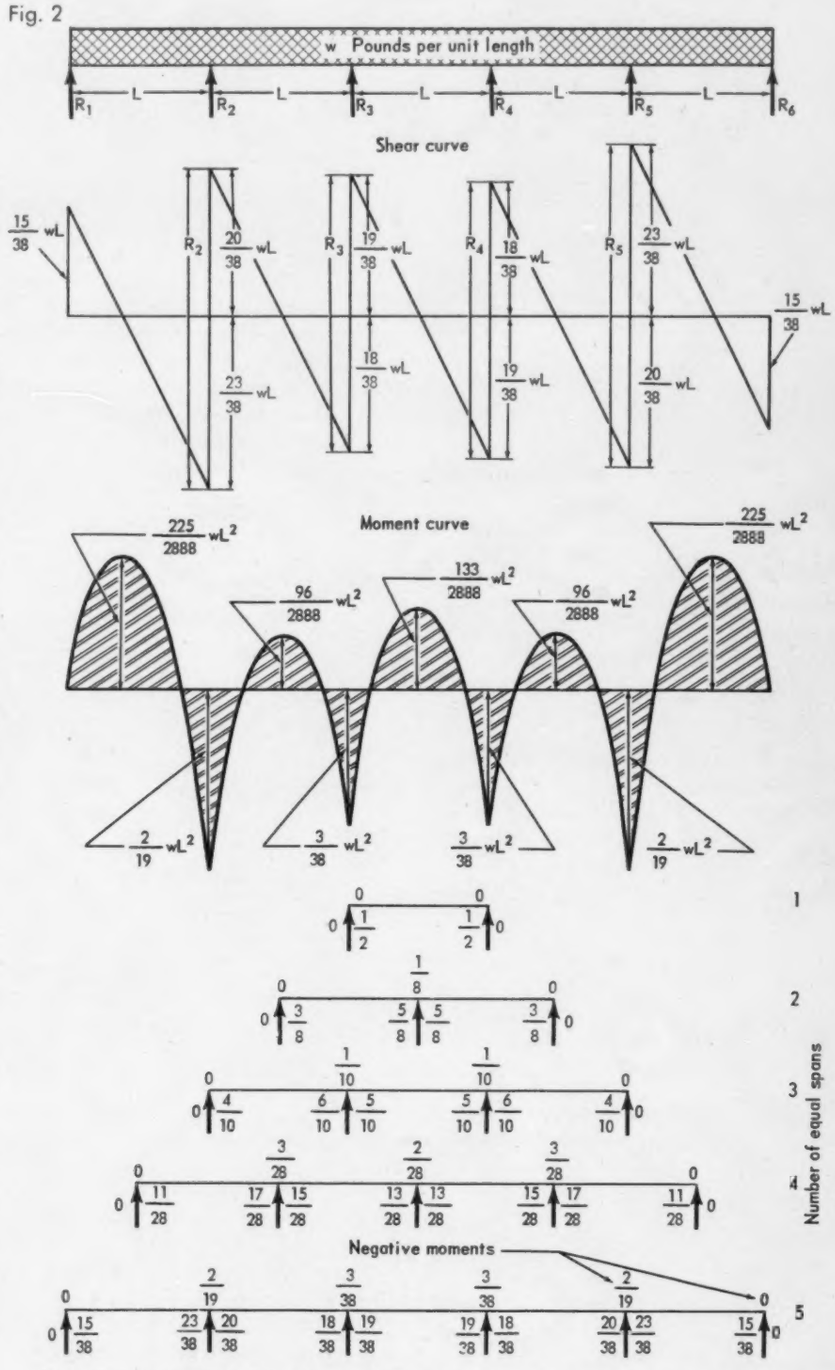
Fig. 2



The diagram above gives values of coefficients from which the negative moments over the supports and the vertical shears at either side of each support may be found for continuous beams resting on supports on the same level having equal spans with a constant uniform load.

(Continued on next page)

Continuous Beams . . . *Cont.*

$R_2 = R_5 = +\ 43/38\ wL$, and
$R_3 = R_4 = +\ 37/38\ wL$

Solution Part (c):

The vertical shear at any section in the first span at the distance x from the left support is:

$V_x = R_1 - wx = 15/38\ wL - wx$

Therefore the vertical shear is zero when $x = (15/38)(L)$ and the maximum moment occurs at this section.

The shear just to the left of support R_2 is:

$V_{-2} = R_1 - wL = 15/38\ wL - wL = -\ 23/38\ wL$

The shear just to the right of support R_2 is:

$V_2 = R_1 + R_2 - wL = 15/38\ wL + 43/38\ wL - wL = +\ 20/38\ wL$

The shear to the left of support R_3 is:

$V_{-3} = V_2 - wL = (20/38 - 38/38)\ wL = -\ 18/38\ wL$

The shear to the right of support R_3 is:

$V_3 = R_1 + R_2 + R_3 - 2\ wL = (\ (15 + 43 + 37 - 76)\ /38)\ wL = 19/38\ wL$

By symmetry
$V_1 = V_6 = 15/38\ wL$
$V_{-2} = V_5 = -\ 23/38\ wL$
$V_{-3} = V_4 = -\ 18/38\ wL$
$V_2 = V_{-5} = +\ 20/38\ wL$
$V_3 = V_{-4} = +\ 19/38\ wL$

Solution Part (d):

The bending moment at any section in the first span is $M_{x_1} = R_1x - wx^2/2$ and the maximum moment occurs when $x = 15/38$ L. Therefore, maximum positive moment
$= (15/38\ wL)(15/38\ L) - w/2\ (15/38\ L)^2$
$= 225/2888\ wL^2$ which is less than maximum negative moment, $2/19\ wL^2$.

The bending moment at any section in the second span is $M_{x_2} = M_2 + V_2x - \frac{1}{2}\ wx^2$
$= -2/19\ wL^2 + 20/38\ wLx - \frac{1}{2}\ wx^2$

The moment is maximum when $x = 20/38$ L since this is the value that makes the shear in the second span equal to zero. Therefore, maximum positive moment
$= -2/19\ wL^2 + (20/38\ wL)\ (20/38\ L) - \frac{1}{2}\ w(20/38\ L)^2 = 96/2888\ wL^2$
which is less than maximum negative moment, $3/38\ wL^2$.

Similarly, $M_{x_3} = M_3 + V_3x - \frac{1}{2}\ wx^2$

Where $x = 19/38$ L
$M_{x_3} = -3/38\ wL^2 + (19/38)\ (19/38)\ wL^2 - \frac{1}{2}\ w(19/38\ L)^2 = 133/2888\ wL^2$

The greatest bending moment that the beam is subjected to is the negative moment at the second and fifth support, therefore, the maximum unit stress in the beam is:

$S = Mc/I = 2/19\ wL^2\ (c/I)$

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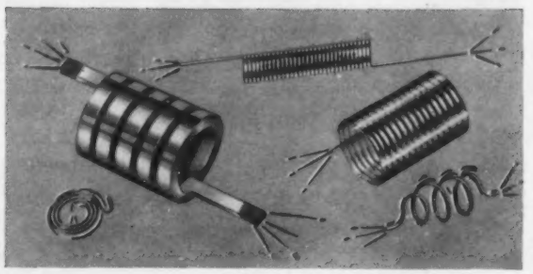
Design may be affected when springs must carry current.

Good electrical conductivity or low electrical resistance of spring materials must be considered in relation to working stresses. When springs must carry current with a minimum of heating, the copper base alloys offer the most logical choice for the spring material. But most of these alloys are relatively low in strength, and the elastic modulus is low also. Since both the strength and modulus affect the design, conductivity and stress must be taken into consideration right at the start.

This conflict between conductivity and strength may be better understood by referring to the bar chart. Here, the bars to the right of the vertical line show the approximate relative tensile strength while the bars to the left indicate relative electrical conductivity of commonly used materials.



Requirements for good conductivity mean generous cross sections and low stresses which minimize the creep tendency of constantly stressed springs.

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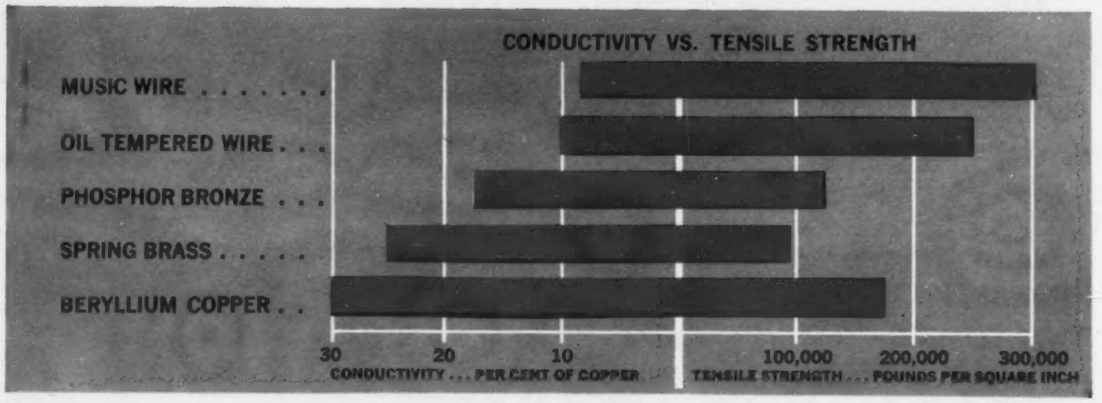
CONDUCTIVITY VS. TENSILE STRENGTH
MUSIC WIRE . . . . . .
OIL TEMPERED WIRE . . .
PHOSPHOR BRONZE . . .
SPRING BRASS . . . . .
BERYLLIUM COPPER . .
30
20
10
CONDUCTIVITY . . . PER CENT OF COPPER
100,000
200,000
300,000
TENSILE STRENGTH . . . POUNDS PER SQUARE INCH

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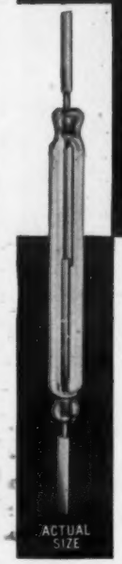
for contamination-free operation...positive on-off switching



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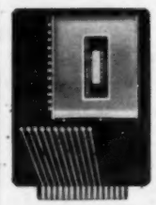

CLAREED relay consists of 12 switch capsules enclosed in a rectangular container and mounted on printed circuit board.

CLAREED relay module for printed circuits. Quick mounting. High component density. Sturdy steel case provides magnetic shield.

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See Clareed Relays in working logic modules... No tubes, no transistors.

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Relays and Related Control Components

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Spindle Speed of Machine Tools

N. Sokolow, Professional Engineer, Newington, Conn.

Spindle speeds should form a geometric progression. By arranging them in this manner, a designer sets a definite limit on the maximum difference (in percent) between optimum speed for the job and speed available. The accompanying chart is useful in the early stage of design, when such questions as how many speeds (n), what range of speeds (V_{max}, V_{min}) and what value of common ratio (r) must be determined.

At this point, it is worth remembering: (1) a good production machine tool will be built with r = 1.2 to 1.45; (2) a machine tool for mass production will have provision for change gears and r = 1.1 to 1.2 (the finer gradation will allow a choice of the best possible speed for the long run), and (3) better design results when n is a product of 2's and 3's. (Example: 18 = (2) (3) (3)).

Example:

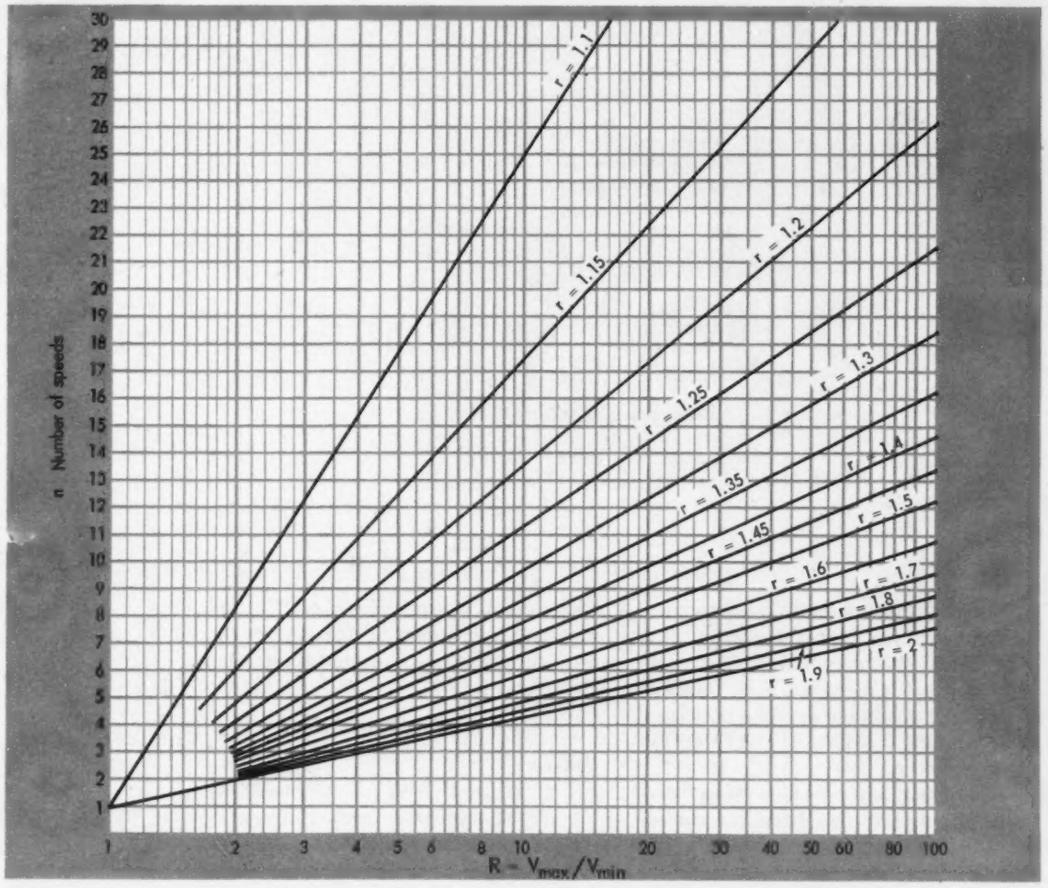
It was calculated, after maximum and minimum size of work was established, that a spindle should deliver:

V_{max} = 1800 rpm and V_{min} = 40 rpm

If r is assumed as 1.25, determine n.

Solution:

$R = V_{max}/V_{min} = 1800/40 = 45$. Entering chart at R = 45, project vertically to r = 1.25, thence horizontally to n ≅ 18. Because this value is not exact, take r = 1.25 and n = 18 and readjust speeds accordingly.



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Nomograms for Press Fits Using MoS_2 Lubricant

Data Courtesy: Alpha Molykote Corp., Stamford, Conn.

High-purity, fine-particle molybdenum disulfide (MoS_2) is particularly notable for reducing friction and eliminating galling under extreme pressure and low-sliding velocity conditions. It is possible to use press fitting more widely and safely than previously possible. Test results indicate that press fits may be designed on the basis of a coefficient of friction of 0.05 for dry powder MoS_2 rubbed on mating surfaces before assembly, and a coefficient of 0.10 if paste form is used. Interferences may be as great as 0.002 inch per inch of diameter.

Testing also indicates that sleeve bearings may be press fitted with less danger of distortion, in some cases eliminating the necessity of finish machining after assembly. Holding power of press fits is, in many cases, sufficient to secure gears, sprockets, clutches, flywheels and cams without keys, set-screws, splines or flats.

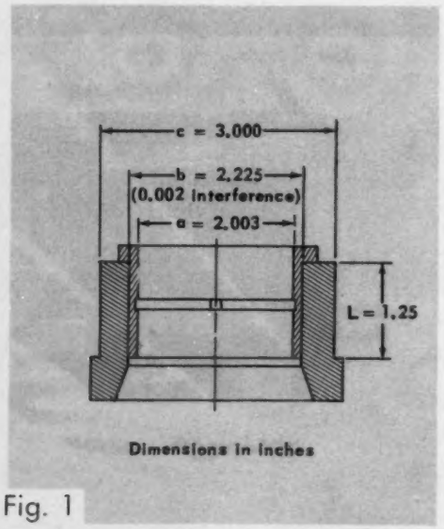

Fig. 1

On the basis of a minimum interference of 0.001 inch per inch of diameter, it has been found that most standard gears up to 6-inch pitch diameter, with standard bores, will maintain maximum permissible running loads before the fit on the shaft will slip.

The nomograms may be used to determine slipping torque from the dimensions of the fitting members (a, b, c and L), the interference (Δb), the modulus of elasticity of mating materials (E_{ab} and E_{bc}) and coefficient of friction of the MoS_2 lubricant (μ). The nomograms solve the equation:

$$T = b/2\,[\pi\mu L(10^6)\,\Delta bN]$$

Where:

N = A stress factor (psi/10^6) based on Timoshenko's method of analyzing shrink fits in thick-walled cylinders. A function of the dimen-

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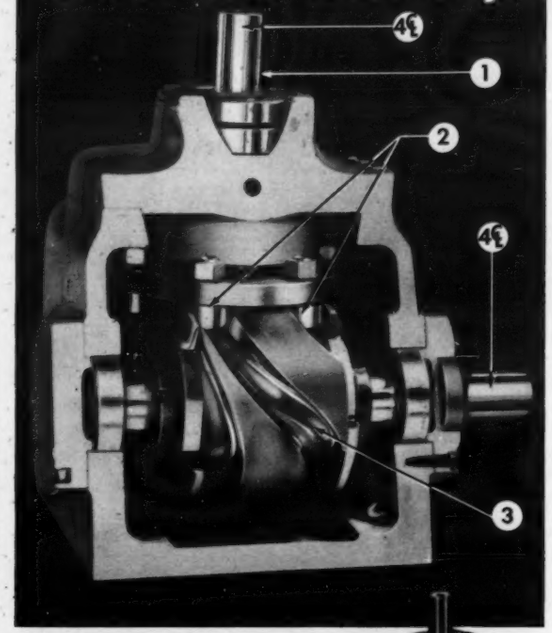

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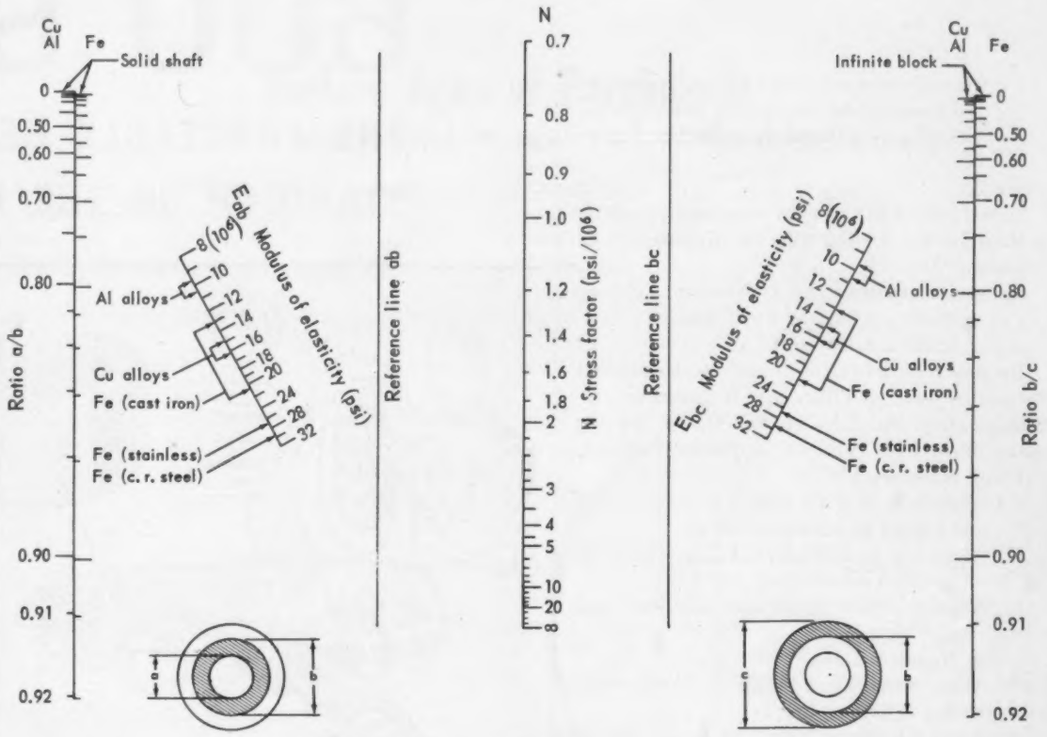
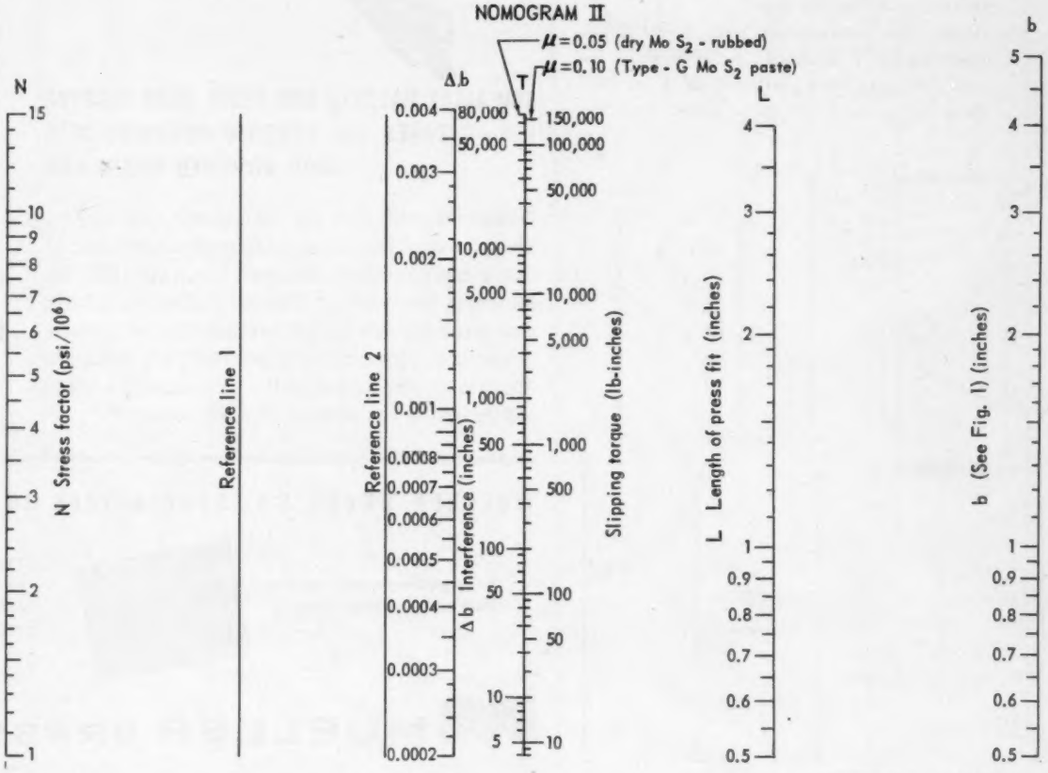
NOMOGRAM I



NOMOGRAM II


μ=0.05 (dry Mo S2 - rubbed)
μ=0.10 (Type - G Mo S2 paste)
N Stress factor (psi/10⁶)
Reference line 1
Δb Interference (inches)
Reference line 2
T
Slipping torque (lb-inches)
L Length of press fit (inches)
b (See Fig. 1) (inches)

(Continued on next page)

Circle 144 on Reader-Service Card for more information

Press Fits . . . Cont.

sional ratios a/b and b/c and the moduli of elasticity of the mating materials E_{ab} and E_{bc}, N is found by use of Nomogram I.

Example:

Given a press fitting with dimensions of parts as shown in Fig. 1, determine the slipping torque.

Solution:

Ignoring shoulders,

$a/b = (2.003)/(2.225) = 0.900$, and

$b/c = (2.225)/(3.000) = 0.742$.

Because both parts are of steel, scales marked Fe will be used. (If either part is copper or aluminum alloy, use scales marked Cu-Al. Double scales result from variation in Poisson's ratio.)

Using Nomogram I:

(1) Align $a/b = 0.902$ with $E_{ab} = 29.5\ (10^6)$ and extend to reference line ab.

(2) Align $b/c = 0.742$ with $E_{bc} = 29.5\ (10^6)$ and extend to reference line bc.

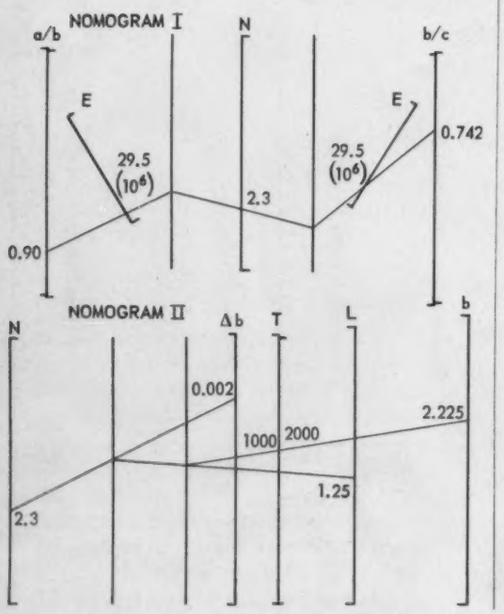
(3) Align intersections on reference lines and read $N = 2.3$.

Using Nomogram II:

(4) Align $N = 2.3$ with $\Delta b = 0.002$, intersecting reference line 1.

(5) Align this intersection with $L = 1.25$, intersecting reference line 2.

(6) Align this intersection with $b = 2.225$, intersecting T scale. $T = 1000$ lb-in for μ of 0.05 (dry MoS_2, rubbed) or $T = 2000$ lb-in for $\mu = 0.10$ (MoS_2 paste, type G).



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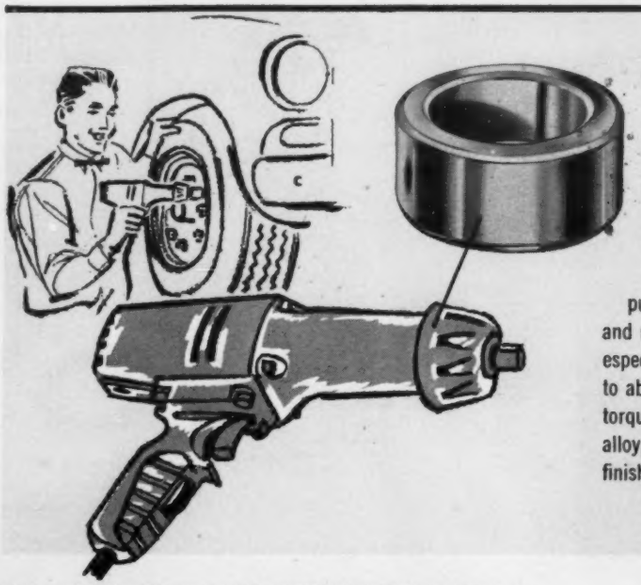
600 SERIES

THE FORGEABLE BEARING ALLOYS THAT STAND UP ON THE REALLY TOUGH JOBS!

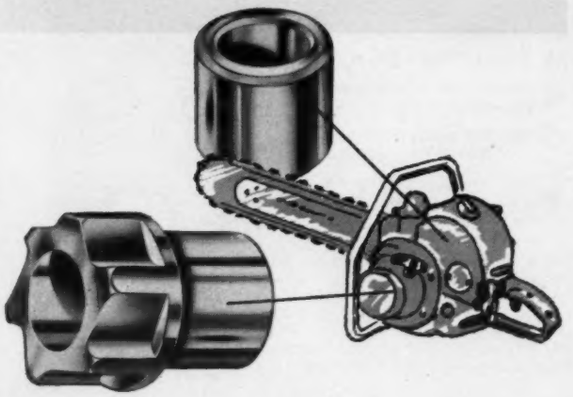


600 ALLOY NOSE BEARING WITHSTANDS THE PUNISHING SHOCK LOADS OF AN IMPACT WRENCH

This heavy-duty impact wrench takes the rigorous punishment of hard industrial use right on the nose . . . and right on the 600 Series nose bearing. This bearing was especially chosen by the manufacturer because of its ability to absorb a range of 1600 to 1800 impacts per minute at a torque of from 0 to 250 foot pounds. By specifying 600 bearing alloy, the manufacturer gets superior performance from his finished product.

600 ALLOY RATCHET AND DRIVE GEAR BEARING TAKES THE TERRIFIC POUNDING OF A HIGH POWERED CHAIN SAW

Professional woodcutters give chain saws a rough time for hours on end, all year round, and these rugged saws must be built to take punishment. With chain speeds up to 3000 feet per minute, the ratchet and drive gear bearings, for example, must have a very high strength, hardness and good resistance to wear with minimum lubrication. That's why 600 Series Alloy was specified for both parts . . . the ratchet is a forging and the bearing was produced from 600 Series rod.



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Blood Brothers has solved more complex universal joint problems than any other manufacturer! Our experienced engineers have designed dependable, specialized units for a wide variety of applications from giant rolling mills to power lawn mowers . . . efficient universal joints from a mammoth 162,000 inch pounds torque capacity to 350 inch pounds.

If you manufacture a product needing a universal joint it will pay you to contact Blood Brothers. Our facilities and know-how will build universal joints to your specifications and to the highest quality. For additional information, write today for your free booklet giving specific data on Blood Brothers Universal Joints.

ROCKWELL-STANDARD CORPORATION
Universal Joint Division, Allegan, Michigan

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Surface Area of Paraboloids

Richard Wadler, Mechanical Engineer, Raytheon Co., Bedford, Mass.

This nomogram solves for surface areas of paraboloids of various diameters and f/D ratios.

Where:

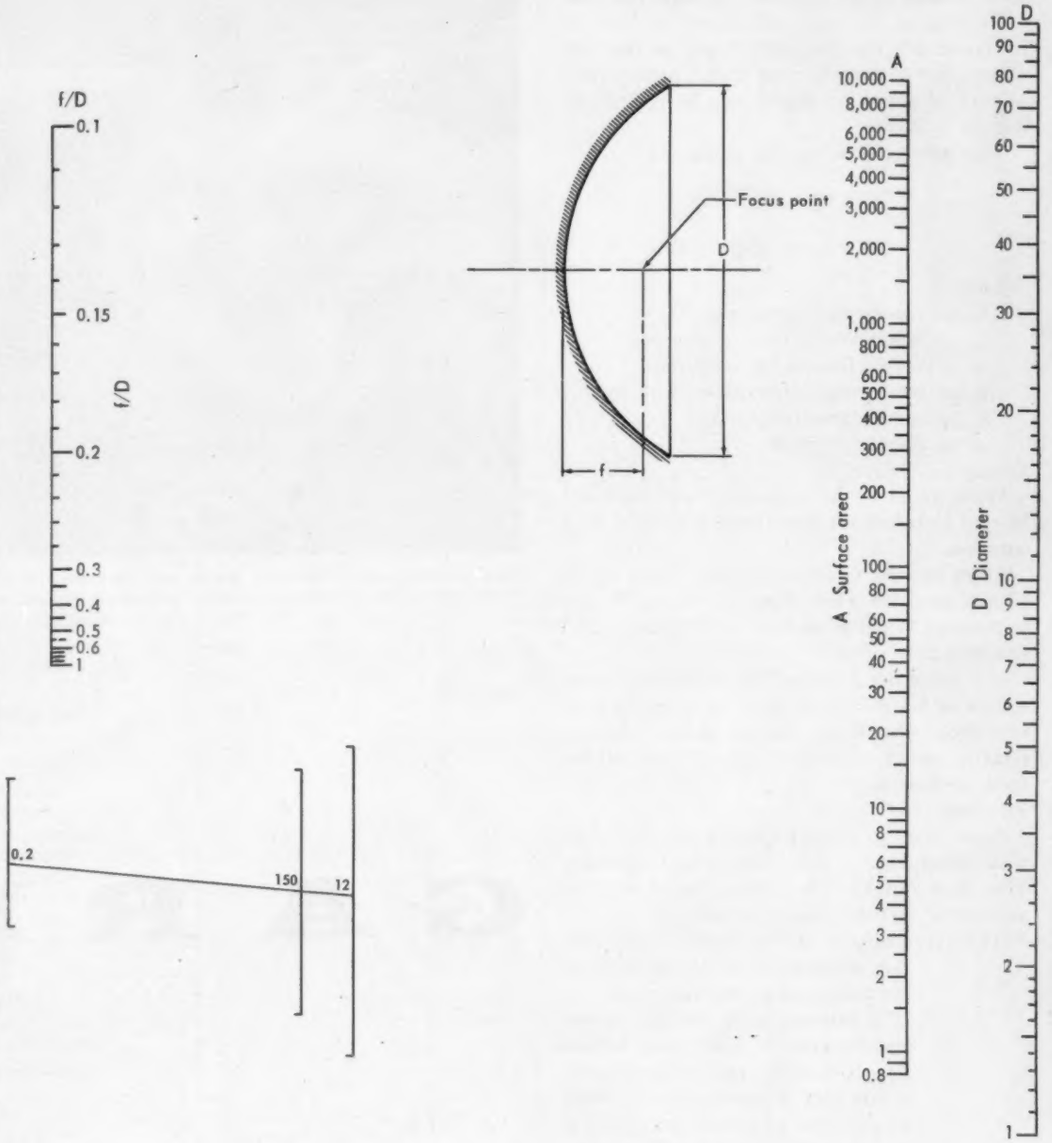
A = surface area, sq in or sq ft
f = focal length, inches or ft
D = diameter, inches or ft

Example:

Find the surface area of a 12-inch paraboloid with an f/D ratio of 0.2.

Solution:

Align f/D = 0.2 with D = 12 and read A = 150 sq in.



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DESIGN DATA...

Liquid Flow Rate Conversion Nomogram

D. J. Lapera, Design Engineer,
Marotta Valve Corp., Boonton, N. J.

When a hydraulic unit such as a valve or pump must be flow tested, it is often convenient to determine the equivalent water flow rate (at the same pressure drop) to permit the more economical testing of the unit with water in place of hydraulic oil. On the other hand, if the unit already has been water flow tested, a conversion to flow of any other liquid may be determined with little effort.

The nomogram solves the equations:

$$Q = Q_w \sqrt{Sg},/ \text{ and}$$

$$w = w_w \sqrt{Sg}$$

Where:

Q = volume flow, gpm or gps
Q_w = volume water flow, gpm or gps
w = weight flow, lb/sec or lb/min
w_w = water weight flow, lb/sec or lb/min
Sg = specific gravity = ρ/ρ_w
ρ = density, lb/cu ft.

Example 1:

What would be the water flow equivalent of a 10-gpm hydraulic oil flow (Specific Gravity 0.9)?

Solution:

Align Specific Gravity (Volume Flow) = 0.9 with Conversion Flow Rate = 10 and extend to intersect Water Flow Rate = 9.5 gpm.

Example 2:

If a valve has a water flow curve that shows a flow of 5.3 lb/min of water at a certain pressure drop, what is the amount of fuel (Specific Gravity = 0.9) that this valve will pass at this same pressure drop?

Solution:

Align Specific Gravity (Weight Flow) = 0.9 with Water Flow = 5.3, intersecting Conversion Flow Rate and read 5.0 lb/min. This then is the amount of fuel that the valve will pass.

NOTE: (1) Units of the equivalent water flow rate are determined by the units of the known flow and vice versa.

(2) It is imperative to use the proper Specific Gravity scales since volume flow is inversely proportional to the square root of specific gravity while weight flow is directly proportional to the square root of specific gravity.

GASKETS
in Design
Engineering

New, ultra-thin Garlock GUARDIAN* Gaskets solve the problem of high-temperature, limited-space sealing on missile and aircraft exhaust systems, turbines, other equipment.

At last—a spiral-wound gasket no thicker than a wedding ring! Ideal for limited space or light flange applications, this new Garlock GUARDIAN Spiral-Wound Gasket is available in thicknesses as thin as 1/16" in gaskets up to 6" I.D., maximum flange width 3/8".

Controlled density affords more positive seal. During manufacture of the new "wedding ring" GUARDIAN Gasket, the proper selected thickness of filler material and preformed metal, the number of laminations of filler and metal, and the correct tension of filler and metal while being formed into a gasket are the factors engineered to achieve proper gasket density. By controlling and varying these factors, Garlock is able to match the density to the pressure range. This built-in quality is constantly checked by a Baldwin-Lima-Hamilton compression-testing machine, thereby assuring perfect sealing regardless of different pressures and different bolt-load requirements.

High-temperature, high-strength construction. This new Garlock "wedding ring" GUARDIAN Gasket operates effectively at temperatures as high as +1900°F and pressures to 2500 p.s.i. or more. It is an excellent gasket where recycling temperatures are encountered. In the 700°F to 1200°F range, Garlock uses a compressed asbestos filler with stainless steel plies; in the 1200°F to 1900°F range, a ceramic filler is used with several different types of metal plies, depending on customer preference. The ceramic is non-flammable, completely inorganic, and an outstanding chemical insulator. It resists mold, mildew, and aging, thereby allowing indefinite shelf life.

Where service is severe and space at a premium, use new Garlock "wedding ring" GUARDIAN Gaskets. They may be the answer to your sealing problems. Find out more from your Garlock representative. Call him at the nearest of the 26 Garlock sales offices and warehouses throughout the U. S. and Canada. Or write Garlock Inc., Palmyra, N. Y.

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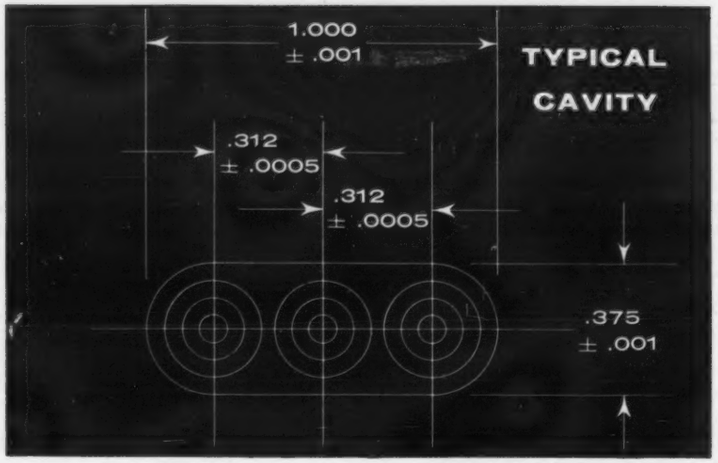

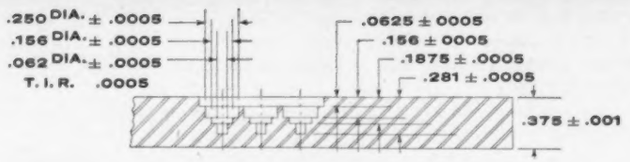

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NEW LITERATURE

Mil-Spec Catalog 451

Carries references on over 450 specifications, and has been found indispensable by many users of specification products in the fields of lubrication, hydraulics, corrosion prevention and similar specialized areas. The list gives military specification equivalent for approximately 300 Aeronautical (AN-), Air Force, Army, Navy, SAE and Aerospace manufacturers specifications. Also available by special request is a list of 90 NATO symbols and the equivalent U. S. specifications. Bray Oil Co., 3344 Medford St., Los Angeles 63, Calif.

Space-Age Silicones 452

Entitled "Silicones for the Space Age", this 16-page brochure is illustrated with photos and charts to enable the user to quickly decide what silicone compound will fit his applications. Also included is comparative data pertaining to silicones and other compounds as high-temperature insulating materials. The brochure covers silicone dielectric and lubricating greases, silicone high-temperature paint additives and masonry water repellents. Silicone Products Dept. of General Electric Co., Waterford, N.Y.

Thermal Insulation 453

Thermal insulations for all types of commercial and industrial requirements, in applications ranging from —400 to 3000F, are described in a newly revised 64-page catalog. Entitled "Insulation Product Information", IN-244A contains 6 complete sections, each devoted to a specialized group of insulations. Information on each product consists of an application photo, description, available forms or types, advantages to users and detailed specification data, including compliance with government specifications and ASTM standards. Type of insulation and its temperature limit are prominently displayed for each product, to facilitate rapid location of pertinent data. Johns-Manville Sales Corp., 22 E. 40th St., New York 16, N. Y.

Plastics Comparison Chart 454

Comparisons of the major properties offered by nine plastics are summarized in graphic form in a 12-page report on cost and performance. Comparison graphs are employed to demonstrate performance of Cycolac GS, nylon, acetal resin, cellulose acetate butyrate, cellulose acetate, modified acrylic, polypropylene, linear polyethylene and high-impact styrene. Six separate graphs compare the plastics for overall performance in these vital areas: cost, measured in cubic inches per dollar; heat deflection at 264 psi; impact strength at room temperature; impact at low temperature; tensile modulus or rigidity; and hardness. A seventh, cumulative properties comparison chart, reveals the total performance value for each of the nine plastics. Borg-Warner Corp., Marbon Chemical Div., Dept. C-2, Box 68, Washington, W. Va.

AGMA Standards Index 455

This is the 1961 American Gear Manufacturers Association listing for all standards in the gear manufacturing field. AGMA Standards Dept., 1 Thomas Circle N.W., Washington 5, D.C.

Tube Replacement Guide 456

Contains complete up-to-date listings for a wide variety of industrial tubes, including backward wave oscillators, counter tubes, gas switching tubes, klystrons, magnetrons, strobotrons, thyratrons, trigger tubes and traveling wave tubes. Code symbols for more than 35 industrial tube manufacturers are listed in concise, easy-to-read tabular form. Sylvania Electric Products, Inc., 1100 Main St., Buffalo 9, N. Y.

Silicones 457

A comprehensive booklet on silicones contains the most recent and advanced information on these important man-made chemicals. Graphically illustrated with photographs, charts and graphs, the booklet goes into detail about what silicones are, describes their manifold uses for consumer and industrial products, and suggests ways in which they can be adapted to a host of new applications by the design engineer or product development manager. Of special significance is the series of charts covering properties and features of silicone fluids, resins, rubber compounds, water repellents, anti-foams and emulsions, and their adaptability for use by the aviation, automotive, chemical, electronic, rubber, paint, paper, textile, glass, metal-working and other industries. Union Carbide Corp., Silicones Div., 270 Park Ave., New York 17, N. Y.

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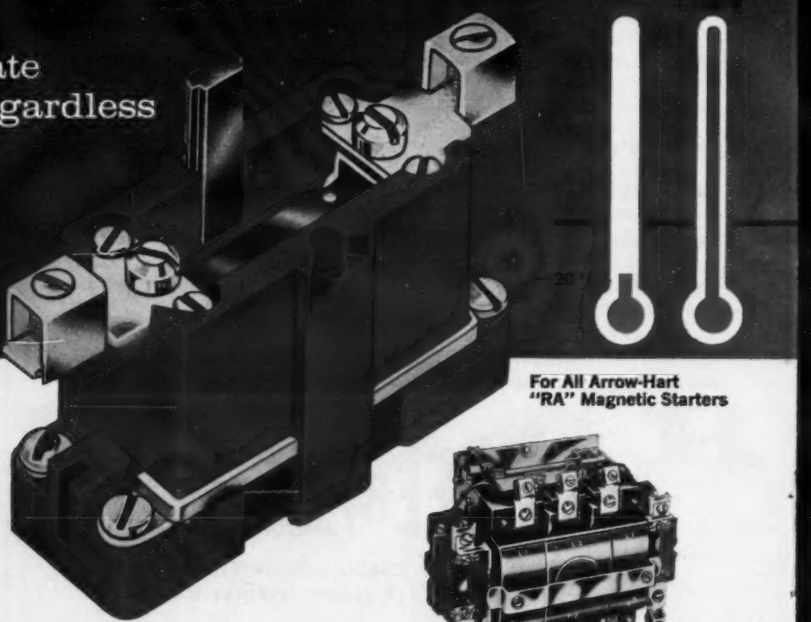

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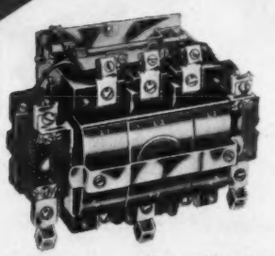


Nema Sizes 0 through 5

To obtain copies of numbered literature . . . circle appropriate number on Reader-Service card.

Synchro and Resolver Manual 458

This 27-page illustrated technical discussion of the electrical characteristics of synchros and resolvers describes in detail applications and significance of such parameters as electrical error, electrical zero, fundamental null, total null, transformation ratio and phase shift. Methods of measurement and basic specifications for test equipment are also included. Theta Instrument Corp., 520 Victor St., Saddle Brook, N. J.

Strain Gage Recording 459

A 4-page application note describing the use of "Autograf X-Y" recorders in strain gage recording. The note, AN-103, describes typical strain gage circuits, and presents a detailed description of three general methods of coupling strain gages to recorders. These include direct measurement of bridge output voltage, common d-c power supply for bridge and recorder, and a-c strain gage excitation. F. L. Moseley Co., 409 N. Fair Oaks Ave., Pasadena, Calif.

Low-Voltage Switchgear 460

Publication GED-4269, 6 pages, describes in detail the reliability, safety and convenience features of Center Unit Substation with Powermaster Type AKD-5 low-voltage switchgear. The literature includes 4-color photographs and an isometric view of the complete compartmentation of the Type AKD-5 low-voltage switchgear. General Electric Co., Schenectady 5, N. Y.

Analog Computer 461

A 20-page brochure describing the model 231R, 100-amplifier, general-purpose analog computer. It describes in detail the basic system, the "building block" design which allows easy expansion and the many automatic features designed for this computer. Also included is a digest of available readout equipment and a 15 by 19-inch full-color reproduction of the new pre-patch panel. Electronic Associates, Inc., Long Branch, N. J.

Pipe/Tube Measurements 462

This 16-page bulletin, No. 631, supplies standard methods of measurements for pipe, tubing and hose, discussing similarities and differences involved. Aeroquip Corp., Jackson, Mich.

Tool Component Applications 463

Prepared to give the designer and engineer a clearer concept of standardized tool components and their varied applications. Case histories, citing specific examples, cover their use as standard parts for jigs, fixtures, tools and dies. Fully illustrated, the 24-page booklet points up the advantages and the savings effected in design and machine shop time, by the use of these standardized tool components. PIC Design Corp., 477 Atlantic Ave., East Rockaway, L. I., N. Y.

Wiring Devices 464

This is an up-dated 1961 index and price-list catalog, listing all electrical wiring components needed to fulfill the complete wiring installation. Pass & Seymour, Inc., Syracuse 9, N. Y.

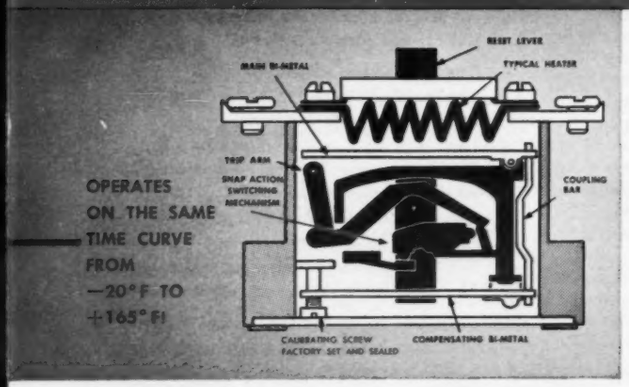
Subminiature RF Connectors 465

Describes adaptors, BNC and TNC plugs. This 12-page catalog of fast assembly "ConheX" subminiature RF connectors for RG and other coaxial cables also includes a nationwide listing of distributors. Sealectro Corp., 139 Hoyt St., Mamaroneck, N. Y.

Cathode Ray Tubes 466

An 8-page booklet on industrial and military cathode ray tubes. Entitled "Bonded Shield", it highlights design and performance advantages of the latest industrial and military cathode ray tubes in which a safety panel is laminated to the faceplate. The booklet lists typical tubes ranging from 5 to 24 inches. Permanent calibrated reference scales, completely protected from abrasion, dimensional information, and tubes with special anti-reflection properties are also described. Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, N. Y.

MOTOR CONTROLS



Here for the first time is a compact, dependable overload relay that compensates for both heat and cold. As shown here, the balancing or compensating bi-metal and the working bi-metal are identical in size and construction and are joined by a coupling bar. As the ambient temperature rises above or falls below 72°F, the balancing bi-metal operates through the coupling bar to maintain the same tripping time over a temperature range from −20°F to +165°F. Compensating action is fully automatic. Relays use standard A-H Heaters and operate equally well with either quick-trip or regular types. The switching mechanism itself employs the same positive snap-action featured in all A-H Overload Relays. Calibrating screw permits precise adjustment at the factory and needs no further adjustment. Available in ratings from 25 to 300 amperes, continuous current, these new Ambient Compensated Relays can be supplied with all sizes of Arrow-Hart "RA" Magnetic Starters . . . or as individual units for use as separately mounted relays.

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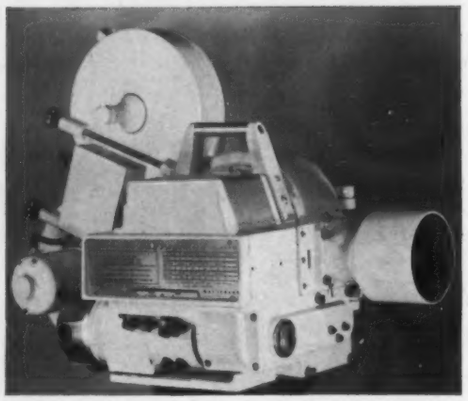

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And so easy to use! No changing of motors and gears for different speeds, because unit is completely self-contained. Just load up and shoot at any of 8 speeds from 200 to 2000 p/p/s. You'll see more detail on the film than ever before . . . in full frame size!

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WF-2S—400' Motion Picture Stop-start
WF-1S—400' Combined Motion Picture-Oscillo-Streak
WF-1SS—400' Combined Motion Picture-Oscillo-Streak Stop-start
WF-21—100' Combined Motion Picture-Oscillo-Streak

S—Stop-start

16mm CAMERAS
WF-3—100' Motion Picture
WF-3T—100' Motion Picture
WF-4—400' Motion Picture
WF-4T—400' Motion Picture
WF-4S—400' Motion Picture Stop-start
WF-4ST—400' Motion Picture Stop-start
WF-9—100' Oscillo-Streak
WF-14—400' Combined Motion Picture-Oscillo-Streak
WF-14T—400' Combined Motion Picture-Oscillo-Streak
WF-14S—400' Combined Motion Picture-Oscillo-Streak Stop-start
WF-14ST—400' Combined Motion Picture-Oscillo-Streak Stop-start
WF-17—100' Combined Motion Picture-Oscillo-Streak
WF-17T—100' Combined Motion Picture-Oscillo-Streak
WF-22S—400' Oscillo-Streak, Stop-start
WF-23—400' Oscillo-Streak

35mm CAMERAS
WF-5—100' Motion Picture, ½ Frame
WF-7—100' Oscillo-Streak, ½ Frame
WF-8—500' Motion Picture
WF-8A—400' Motion Picture Metric Camera
WF-8—100' Combined Motion Picture-Oscillo-Streak
WF-10—400' Oscillo-Streak, ½ Frame
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The control unit consists of a variable AC transformer capable of outputs up to 280 volts which permits maximum operating speeds. In addition, a set of electrical timers make possible synchronization between the camera and event being photographed.

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with Control Console. Portable, rugged, highly efficient. Operates from low voltage DC supply . . . has high percentage of light collection, and color is exactly comparable to daylight. Pictures can be taken as fast as 16,000 pps on color film ASA8.

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LITERATURE

Transistors 467

This publication gives electrical specifications and dimensional drawings along with a brief note on operating characteristics of 4-layer diodes. Shockley Transistor unit of Clevite Transistor, Stanford Industrial Park, Palo Alto, Calif.

Traction Motors 468

GEA-7309, a 4-page publication, lists features and advantages of the 6⅝-inch dia "JB" traction motors for low-voltage d-c electric vehicles. Bulletin contains photographs showing disassembled motor. Charts of typical motor speed torque curves and tables of ratings and dimensions are included. General Electric Co., Schenectady 5, N.Y.

High-Speed Computing Systems 469

Details operational features and includes recently announced improvements in G-20 computing, magnetic tape and line printer speeds. Bulletin QC-020-R110 describes increased memory and processing facilities of control buffers, as well as communication systems. Basic, medium and large G-20 systems are depicted in the brochure. Bendix Computer Div., 5630 Arbor Vitae, Los Angeles 45, Calif.

Direct-Reading Micrometers 470

The "Speedmike" and "Snap Gage" micrometers are described in detail in this catalog sheet. Literature includes information on advantages of direct-reading micrometers over conventional types and explains how "Snap Gage" micrometer may be used to eliminate an entire set of fixed snap gages. Information on optional features and optional terminals available is also included. J. T. Slocomb Co., 68 Matson Hill Rd., South Glastonbury, Conn.

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9. Ball-bearing; almost service-free design.
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Gast Air Motors are supplied as original equipment on pneumatic hoists, mixers for paint and chemicals, fans, blowers, fuel hose-reel rewinders, liquid pumps, spooling machines and a host of other products. Used in explosive atmospheres and in "hot" locations to 250° F.

Model No.	1AM	2AM	4AM	6AM	8AM	16AM
H.P. at 90 P.S.I., 2000 RPM	0.13	0.57	1.1	2.0	4.0	7.0
Weight, lbs.	1½	5½	8	17	25	65

For complete performance data, write for Air Motor Bulletins. Specify models that interest you.

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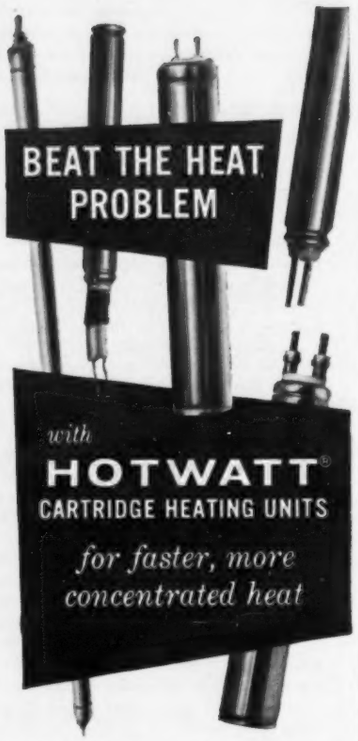

Next time you require intense yet localized heat in any of your equipment, specify Hotwatt cartridge heating units. Hotwatt cartridges come in a wide range of standard and special types and sizes to give you heat where you need it — in a hurry.

And, as an added bonus, Hotwatt's unique manufacturing process assures faster deliveries to your plant. Hotwatt has in-stock all the necessary materials to process your orders quickly.

Hotwatt cartridges are designed for long, trouble-free service. Standard units feature precision-made stainless-steel sheaths; maximum surface temperatures to 1250°F.; etched, not stamped, designations to preserve accurate shape; moisture resistance; maximum heat transfer and minimum core temperature; heating element supported on superior ceramic and solidly packed with magnesium oxide.

Discover for yourself what so many other companies have found out: Hotwatt units are your best buy in cartridge heaters.

HOTWATT
WRITE on your letterhead for your free copy of this catalog which has full details on the Hotwatt line. The catalog also contains all basic formulae to allow you to determine wattage capacity required for different materials.

HOTWATT, INC.

75 MAPLE ST., DANVERS, MASS.

ELECTRIC HEATING SPECIALIST

Circle 152 on Reader-Service Card

Fastener Inserts **471**

Describes advantages of using expandable-type inserts in plastic parts after molding, versus molded-in inserts. Drawings illustrate procedure for installation in various applications. A chart on standard sizes is also outlined in the 4-page catalog. Fastener Products, Inc., 239 Danbury Rd., Wilton, Conn.

'Heat Treat Review' **472**

Contains an interesting article on safety standards for heat-treating equipment, which outlines responsibility of equipment users, furnace manufacturers and insurance associations. Other articles cover a discussion of bell-type coil annealing furnaces which utilize power convection, and also a case history of commercial heat treater who could not expand his plant because of land shortage but found a way to double his production. Midland-Ross Corp., Surface Combustion Div., 2375 Dorr St., Toledo 1, Ohio.

Rotary Solenoid Drives **473**

Offers technical data on a rotary solenoid drive designed to remotely control any "Blue Line" switch, regardless of contact development and configuration. Described in the text are operating principles, methods of control, applications and modular construction features. Also included are specifications, complete dimensions and ordering information. American Solenoid Co., Inc., U. S. Highway 22, Union, N. J.

Photocopying Materials and Methods **474**

"Photocopy News and Reproduction Review" describes diffusion transfer photocopying papers and films. Special papers-and-films section covers more than two dozen photocopy papers and films—both negative and positive—and charts many of the special uses for various combinations of these materials. Four pages include descriptions of a new photocopier, techniques for copying continuous tone photographs, and details on a new photographic-contact arc-light proofing paper for lithographs, blueprints, photoengraving and art departments. Anken Chemical & Film Corp., Ampto, Inc., Newton, N. J.

Electric Motor Components **475**

Tab indexed for easy reference, this catalog shows molded brush retaining caps, carbon brush holders, commutators, and slip rings. Midwest Molding & Mfg. Co., Gurnee, Ill.

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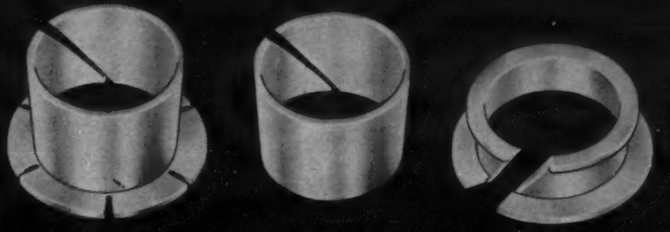
LONG LIFE, *THOMSON* "Snap-In"

NYLINERS®

—BEARINGS of smooth, tough DuPont NYLON



Low Cost FLANGED Nyliner | Low Cost SLEEVE Nyliner | Low Cost DOUBLE-FLANGE Nyliner

COST LESS to BUY
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& ELIMINATE LUBRICATION

Additional Benefits:

- CLOSE FIT
- LONGER LIFE
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- LESS SERVICING
- SELF-RETAINING
- RESIST CORROSION
- LOW FRICTION
- RESIST POUNDOUT
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- DAMP VIBRATION
- OPERATE IN LIQUIDS
- NON-CONTAMINATING
- INSTANTLY REPLACEABLE
- RESIST ABRASION
- MINIMUM SPACE
- SILENT OPERATION
- LIGHTEST WEIGHT
- REDUCED WEAR

Engineered to Solve Problems . . . Improve Products . . . Reduce Costs!

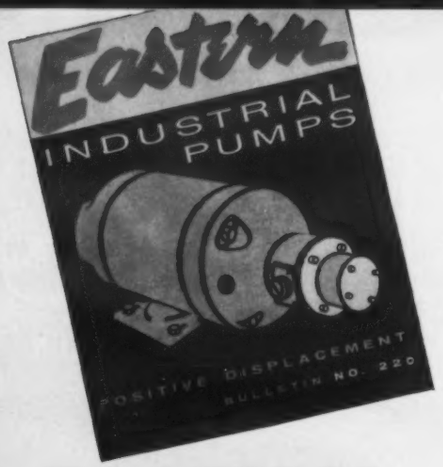
NYLINER Bearings are a highly engineered thin liner of DuPont Nylon, designed to bring bearing users the many benefits of Nylon as a bearing material by solving most of the limitations surrounding its use. The compensation gap principle assures maintenance of diametral tolerances for precision applications.

Seven Standard Types available from stock. Write for literature and name of your local representative who stocks NYLINER Bearings for immediate shipment.

THOMSON INDUSTRIES, Inc.

DEPT. 2, MANHASSET, NEW YORK

Also— —Manufacturers of BALL BUSHINGS . . . the Ball Bearing for Linear Motions and 60 CASE . . . Hardened & Ground Steel Shafting



EASTERN takes the gamble out of selecting

POSITIVE DISPLACEMENT PUMPS

If you have a performance requirement for pumps which can deliver a pulsation-free flow of non-lubricating liquids at pressures up to 200 psi on the gear type or rates up to 6 gallons per minute on the vane type, pick a winner from the big Eastern line.

For small volumes against relatively high pressures, the Eastern GW series gear pumps are a natural. In each pump, oversized bearings of impregnated graphite support a drive gear of stainless steel and an idler of special bronze material. These self-priming units require no lubrication and cannot contaminate the liquid being pumped.

For volumes from 1.5 to 6 gpm and pressures to 60 psi, you can't beat Eastern VW series vane pumps. These highly efficient units are designed around a cam-shaped pumping chamber assuring pulsation-free liquid flow. Vanes are held in positive contact with the pumping chamber at all times — and their positioning is independent of hydraulic pressure or centrifugal force. Composition carbon graphite bearings and vanes require no lubrication beyond that of the liquid being pumped.

All Eastern positive displacement pumps are close-coupled with motor or can be furnished less electric motor with belt stand for belt or coupling drive.

Don't make your points the hard way — play safe and write for Eastern's new Bulletin 220 on positive displacement pumps.

Other Eastern products:

- ***hydraulic motors***
- ***gear pumps***
- ***centrifugal pumps***
- ***aircraft pumps***

EASTERN INDUSTRIES PUMP DIVISION

EASTERN INDUSTRIES INCORPORATED

Hamden, Connecticut

LITERATURE . . .

Precision Wire 476

With illustrations, charts and diagrams, this bulletin describes temperature resistance, specific resistance, resistance and temperature coefficient tolerances, yield strength versus diameter for varying temperatures, elongation versus diameter for varying temperatures, and other details pertinent to "Moleculoy" wire and its applications. Molecu Wire Corp., Eatontown-Freehold Pike, Scobeyville, N. J.

Computer Technology 477

"New Solutions in the Science of Simulation" is a 20-page illustrated brochure detailing the latest advances in computer technology and equipment. The informative brochure presents a run-down on the company's history and capabilities, as well as the company's line of precision products and components used as accessories to central computer consoles and for other applications. One section is devoted to a review of projects in which equipment is being used to solve complex simulation problems of astronautics, astrophysics, ballistics, chemical and atomic research, process design and industrial manufacturing systems. Computer Systems, Inc., Culver Rd., Monmouth Junction, N. J.

Time-Saving Shop Tools 478

This 24-page catalog No. 1161CJ describes all of the manufacturer's tools, including the "Speedi-Spacer" and "B" series clamps, as well as a complete line of machine vises, rotary tables and other work-holding and positioning devices for the metal-working industry. Universal Vise & Tool Co., Parma, Mich.

Power Supply Design 479

An illustrated 4-page brochure explains a new power supply design with 5 advantages. Complete specifications including the range of the continuously-variable current limiting, instructions for parallel operation and fine regulation are given. Valor Instruments, Inc., 13214 Crenshaw Blvd., Gardena, Calif.

Circle 154 on Reader-Service Card

To obtain copies of literature without Reader Service number . . . write to company on your letterhead, mentioning DESIGN NEWS.

O-Ring Slide Rule Chart

A simple-to-use slide chart to assist design and production engineers in the specification of "Metal-O-Rings". The chart covers ring diameters from ¼ to 50 inches and includes specifications for plain, plated and coated rings. By setting the slide rule at the desired nominal outside diameter for any standard ring, the proper installation dimensions may be quickly and easily determined. For non-standard size rings, the chart also gives complete data on how to calculate the correct installation dimensions. The slide charts are available by writing Mr. Arthur Hostage, Sales Promotion Manager, Advanced Products Co., 59 Broadway, North Haven, Conn.

Tool Steel Catalog

Features a simple, up-to-date selector for 24 varieties of tool steel. Catalog gives composition and properties and suggested applications for each steel, followed by detailed instructions for heat treatment and a complete stock list. Hundreds of applications are given in the 144-page catalog, with the suggested steel in an easy-to-use, index-type steel selector at front of catalog. In addition, many tool-steel specialties are described, including castings, forgings, drill rod, flat-ground stock and tool bits. Darwin & Milner, Inc., 2222 Lakeside Ave., Cleveland 14, Ohio.

Electrical Components

A complete reference to industry, covering rotating equipment including motors and blowers, reducers and electronic components. The 176-page catalog represents a handy desk-top guide to give the buyer easy accessibility to over 5000 industrial motors and gear reducers and over 25,000 industrial electronic parts. Industrial users will find a wide selection of such lines as cable, capacitors, speed controls, converters, dynamotors, insulators, meters, motors, rectifiers, reducers, relays, resistors, sockets, transformers and tubes. Items are fully illustrated, conveniently indexed and accurately and clearly described. Electro Sales Co., Inc., 50-58 Eastern Ave., Boston 13, Mass.

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Swagelok®

BULKHEAD CONNECTIONS

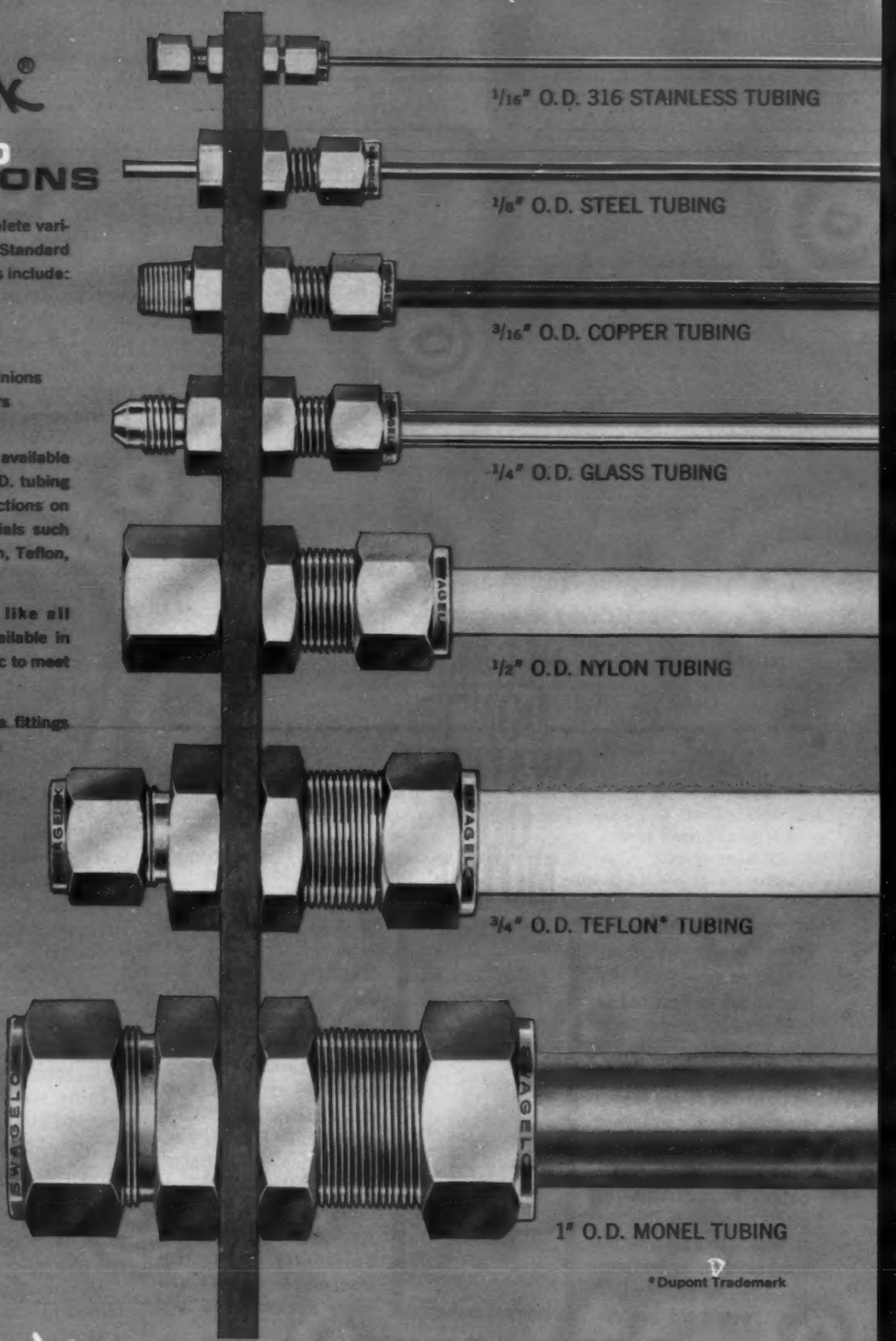
Only Swagelok has such a complete variety of Bulkhead Tube Fittings. Standard Swagelok Bulkhead Tube Fittings include:

- Bulkhead Unions
- Bulkhead Adapters
- Bulkhead Male Connectors
- Bulkhead Swagelok to AN Unions
- Bulkhead Female Connectors
- Bulkhead Reducing Unions

Swagelok Bulkhead Fittings are available in sizes for 1/16" through 1" O.D. tubing and can make leak tight connections on a wide variety of tubing materials such as stainless steel, monel, Nylon, Teflon, glass, copper, steel, etc.

Swagelok Bulkhead Fittings, like all Swagelok Tube Fittings, are available in any machineable metal or plastic to meet your particular requirements.

Remember, whether you require fittings for the simplest application or the most demanding, whether it is unusual tubing material, unusual fitting material or unusual fitting types, Swagelok Tube Fittings solve your problem.



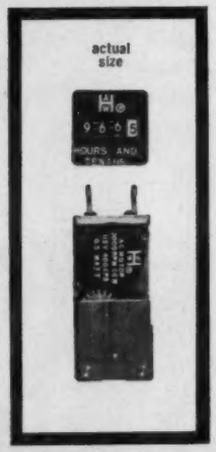
*Dupont Trademark

Swagelok® TUBE FITTINGS SOLVE YOUR PROBLEMS

CRAWFORD FITTING COMPANY • 884 EAST 140th STREET • CLEVELAND 10, OHIO
CRAWFORD FITTINGS (CANADA) LTD., NIAGARA FALLS, ONTARIO, CANADA

PLEASE DON'T SWALLOW OUR MOTOR

...IT'S HIDING BEHIND THE ASPIRIN. Actually, we set out to build an easy-to-read tiny timer...but we first had to build an aspirin-sized motor to drive it. This assignment might have been a headache for a sorcerer, but A. W. Haydon did it. And there is something magical about these micro-miniature elapsed time indicators and companion events counters. ■ This digital elapsed time indicator has many outstanding features: size is only ½" square x 1 1/16" long...weight .75 ounce...



meets all mil specs...temp. range –54 to +125°C...vibration to 2000 cps at 20 G...choice of two ranges (hours to 9999, tenths to 999.9)...power input .5 watt, max. In fact, the complete data outweighs the equipment. Send for our heavyweight literature on the 19200 ETI right now. ■ Electrical or electronic, the A. W. Haydon Company works wonders in time. For electronic requirements call Culver City. For electro-mechanical devices call on our wizards in Waterbury.

THE AWH HAYDON COMPANY
236 NORTH ELM STREET, WATERBURY 20, CONNECTICUT

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TECHNICAL PAPERS

Hydraulic Fluid Contamination

C. B. Davis and G. L. Wenner,
The Martin Co., Denver, Colo.

Fluid contamination may be defined as any foreign matter present in a fluid which adversely affects either the fluid or the equipment with which it must operate. This paper concerns itself only with those contaminants which affect the equipment directly or otherwise. Contaminants in this category are solids, fluid additives and water. A brief description of each contaminant type follows:

Solids

Solid contamination describes that amount of insoluble particulate matter necessary (either from the standpoint of size or quantity) to present a functional hazard to the equipment through contamination of the fluid. Contamination of this type may be divided into two classes of particles—fibrous and nonfibrous. Fibrous particles are threads or thread-like objects which usually are organic in nature. The length/diameter ratio is most often quite large.

Nonfibrous particulate contamination defines any solid contamination, present in the fluid, that is not classified as fibrous. This category is composed of metal, mineral and certain nonfibrous organic materials. Nonfibrous particles rarely take the form of a perfect geometrical shape (sphere, cube) but almost always appear as chips, shavings or chunks.

Fluid Additives

Normally, when we speak of additives relative to hydraulic fluids, we speak of subtle adverse influences. Fig. 1 illustrates the point.

In the servovalves used in today's missile guidance systems, the high threshold responses encountered present severe contamination problems. Contamination may be alleviated by:

1. A higher degree of contamination control.
2. Major redesign of the servovalve and other fluid components to accommodate passage of larger particles.

In our approach to the problem, we are concerned primarily with methods of contamination control designed to achieve a higher level of cleanliness. With MIL-H-5606A and MIL-H-6083B, present methods are insufficient to produce absolute values of 2-, 5- or 10-micron size in production missiles.

Straits Tin Report

Tin-lined copper tube recently developed combines tin's corrosion resistance and malleability with the strength and ductility of copper. Pure molten tin is gas-propelled through the tubing to form a continuous, fusion-bonded tin lining that will not chip, crack or peel, and can be

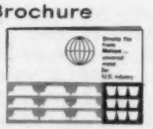
Photo courtesy Phelps Dodge

bent, flared, flattened or soldered. Tin provides immunity to corrosive sulfur conditions found in some natural gas and petroleum products; affords excellent resistance to flaking action that can plug lines and orifices and create hazards with gas appliances. The tin lining also prevents contamination of fluids in process lines of food, beverages, pharmaceutical and water distilling equipment and for sampling lines to laboratory or control instruments, according to its producers, Phelps Dodge Copper Products Corp.

Acid pickling of steel before hot tinning produces maximum bond strength of bearing metal to steel. Shot blasting preparation lowers bond strength, possibly because of distortion, folding and flowing during precleaning.

FREE Brochure

16 interesting pages of information about the latest uses of tin in U.S. industry. Write today for your copy.



The Malayan Tin Bureau
Dept. S-26C, 2000 K St., N.W., Washington 6, D.C.

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"know-how" pays off in Tubular Part Fabrication

• UNIFORM TUBES' know-how solved the problem of right temper and grain size needed to bell the ends of this nickel, electronic tube part without thinning the wall. Their special tooling permitted close concentricity and dimensional tolerances.

• Mass-producing this light meter pointer required unique tooling skills and extreme precision of aluminum tubing stock. Fabrication involves coining and bending to exact thicknesses and angles in three planes while maintaining perfect centerline parallelism.

• To make this missile component fit perfectly, UNIFORM TUBES had to bend .250" O.D. x .035" wall stainless steel tubing, maintaining end roundness and holding O.D. variations to less than .002" despite the complication of cutting one end along the radius of a bend.

Tell us your fine seamless tubing or tubular part needs, and save time and expense.

UNIFORM TUBES, INC. COLLEGEVILLE 2, PA.
HUxley 9-7276 TWX-CGVL 1044

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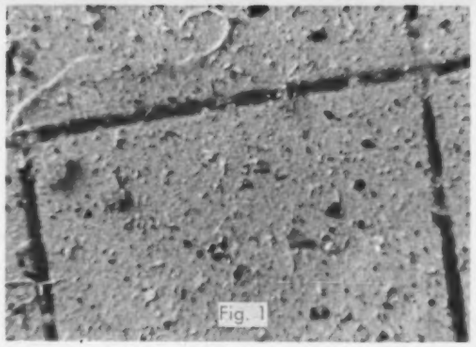


We are penalizing the missile industry by using fluid designed for long-life usage in manned aircraft. A hydraulic fluid developed to satisfy all of the desired requirements would not only increase the design possibilities of servo controls, but would advance overall reliability of the flight vehicle.

Water Content

In general, it can be said that water content of hydraulic oils has presented no problem to Martin-Denver.

Mechanical

During the manufacture or buildup of a hydraulic system, all steps of manufacture must be controlled to some degree if the finished system is to be sufficiently free of contamination to assure successful operation. Consequently, manufacturing must be planned from the raw stock work to the finished article stage to eliminate as much contamination as possible. Contamination control philosophy should be an ever-present factor in the fabrication planning for both components and systems.

Residues from cleaning efforts account for a small portion of the contamination present in a hydraulic system.

The environment in which a system or its components are cleaned and assembled can affect the final cleanliness of the entire system. A "clean" or contamination-controlled environment, commonly referred to as "dust free", will do much to assure cleanliness of the system.

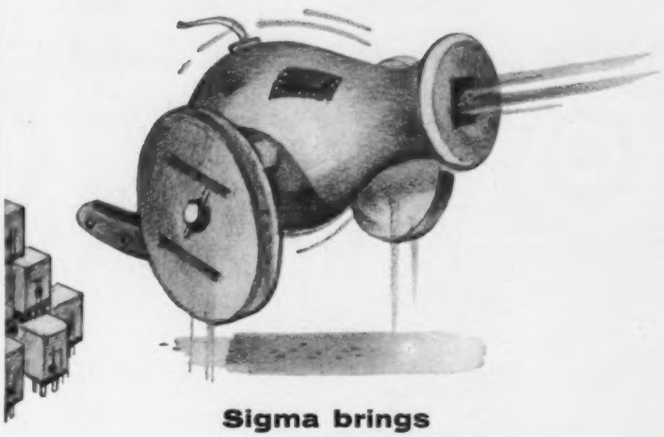
Personnel

Improper training of personnel working on a component or system can negate all engineering and quality control safeguards for contamination control.

In addition to training the working personnel in concepts of contamination control, it is also important to acquaint supervisors with their responsibility in the overall contamination control program.

Finally, attitudes of management concerning acquisition of equipment, space allocation and personnel for control operations are of obvious importance to success of the overall program.

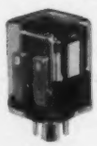
(Continued on next page)



Sigma brings big gun to bear on commercial relay field

There's a new Sigma relay just coming into the picture that's so disarmingly simple in design, construction and operation that Believers in Complexity will probably get mad when they see it. (After all, if you give someone a simple answer to anything nowadays they think that you couldn't possibly have understood the problem.) But the reaction around here is that the designer's really got something, and there was even talk about erecting a small monument to him in the parking lot.*

We were going to call this new general purpose AC-DC relay the "Series 90" until there was some rumbling in the number department, so now it has the much more economical, sensibly conservative number of 46. It's an honest-to-goodness *good* heavy duty commercial relay, that will switch up to 10 amp, 120-volt resistive loads on as little as 200 mw. DC or 0.5 v-a AC. What the big simplicity pitch Means To You is that there are so few parts it's almost impossible for anything to get out of whack; the few parts it *does* have aren't hard to make or assemble (translated, $3 or $4 per relay in quantity); a big motor and fat DPDT contacts efficiently use every bit of the volume and give a long mechanical life — from 500,000 operations on 10 amp loads to 10 million operations at no load. Since we hope the "46" will find its way into such things as machine tool controls, timers and laundry equipment (and even smarter Electronic Devices as well), the octal plug-in base has the same pin connections as the relays already sitting in this type of equipment. If you want to call this a retrofit, go right ahead. That's it there in the picture, in a revealing 1 5/16" x 1 5/16" x 2 1/16" plastic enclosure.



The first few thousand are now beginning to roll, and while we're not quite ready to talk delivery by the carload, anyone interested in trying out 46's in sample quantities will get to sit in the sales manager's padded office for 8½ glorious minutes.

**We decided not to overdo it and gave him a Rolls-Royce instead.*

Series 46 Relays and other selected Sigma products and personnel on display at booths 2628-2630, New York Coliseum, March 20 to 23. Come energize them.

SIGMA

SIGMA INSTRUMENTS, INC.
53 Pearl Street, So. Braintree 85, Mass.

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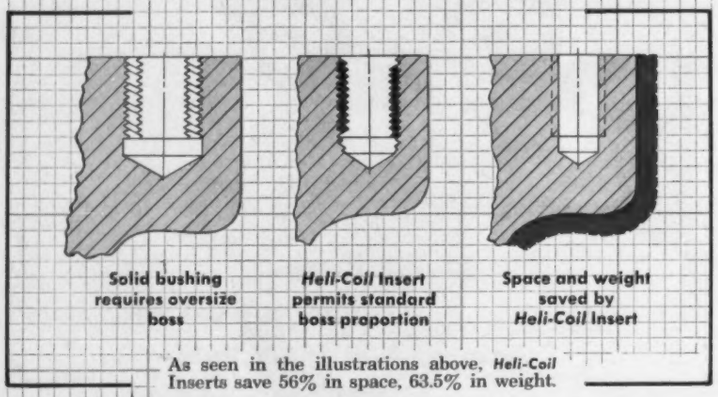
How You Can Save Boss Space and Weight in Thread Design ...with HELI-COIL® Inserts

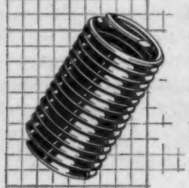

Solid bushing requires oversize boss
Heli-Coil Insert permits standard boss proportion
Space and weight saved by Heli-Coil Insert

As seen in the illustrations above, *Heli-Coil* Inserts save 56% in space, 63.5% in weight.

Heli-Coil stainless steel wire inserts have a smaller outside diameter than any solid bushing. Therefore, with ***Heli-Coil*** Inserts you can design boss radii to a minimum, yet stay with standard boss configurations. This means *savings in space and weight*, and material-savings as well.

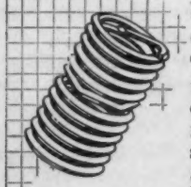
This feature is vitally important for miniaturization in aerospace design, in electrical and electronics equipment design, and for general industrial applications.

NO OTHER TYPE OF INSERT OFFERS SUCH SAVINGS!



Heli-Coil Standard Insert
for stronger, smoother, lifetime threads

Permanently protects threads against wear, stripping, corrosion, galling, seizing, vibration, and shock. Made of 18-8 stainless steel wire, this precision-formed ***Heli-Coil*** Insert has a tensile strength of approximately 200,000 psi. Conforms to military standards and all commercial and industrial thread forms.



Heli-Coil Screw-Lock Insert
eliminates lock wiring and lock nuts

This one-piece wire Screw-Lock Insert provides all the thread protection of the Standard Insert, PLUS an exclusive resilient *internal* locking feature that eliminates clumsy protruding lock nuts, lock wiring and other supplementary locking devices. *It saves cost, space and weight* – permits simple streamlined design in standard bosses. Meets military and N.A.S. specifications for locking torque and vibration.

The Heli-Coil line of products includes: inserts and related taps, hand tools, power inserting tools, automated tooling, and gages. Tables of boss radius and weight comparison are available. Write for complete details and design data. 2565A

HELI-COIL CORPORATION
3303 Shelter Rock Lane, Danbury, Connecticut
In Canada: ARMSTRONG BEVERLEY ENGINEERING LTD.
6975 Jeanne Mance St., Montreal 15, Que.

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Hydraulic Fluid . . . *Cont.*

Proper tools and equipment maintained in an adequate facility are essential to contamination control.

Systems

A major contributing factor to contamination is involved in the assembly and testing of a part or system. Sources of contamination include:

1. Lubricant used on fitting.
2. Dust-free area not available for final assembly of large missile sections.
3. Small metal particles produced during mating of tube and fitting.
4. Over-torquing of fittings and other incorrect assembly techniques.

The major portion of the above problems can be reduced by adequate training of personnel. In those cases where such training is not feasible, other methods must suffice. At Martin-Denver, for example, a system flushing procedure follows assembly.

Design

Components make the system, particles yield contamination, and contamination produces trouble. In the basic design of a fluid component, parameters are set up for leakage rates, materials, temperatures, type of seals, and response, flow and pressure requirements. Since all of the design parameters depend on the type of fluid and its contaminate level, this, in essence, provides the foundation for the parameters.

Design of the components in a hydraulic control system is, therefore, of utmost importance in controlling the contamination level.

Pumps, accumulators and actuators are often classified as contamination generators.

The hydraulic pump is the worst offender. Indeed, many missile manufacturers require run-in time by the vendor until a leveling-off of contamination is obtained.

The system accumulator is subjected to high-frequency and low-amplitude impulses which reflect numerous pressure applications on the piston seal, and this creates additional contamination.

The actuator servovalves demand a major part of the contamination control efforts. This is because of small orifice sizes for flapper control and the minute clearances on directional spools. Filters provide some protection of these vital areas.

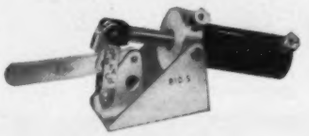
Obviously, cleanliness of the fluid used in a hydraulic system is the determining factor toward functional longevity of the components.

Cleaning of the subassemblies and assembled

IT'S A FACT
YOU CAN DO BETTER WITH

DE-STA-CO

AIR-OPERATED TOGGLE CLAMPS



600-4000 lbs. holding pressure

300 to 900 lbs. clamping pressure

De-Sta-Co air-operated clamps are built to give long, trouble-free service . . . hardened bushings and pivot rods are standard of the many quality features.

Clamping and unclamping are both actuated by normal air line pressure of 90 lbs.

Whatever the use: Series, sequentially, simultaneously . . . or individually, De-Sta-Co air-operated Toggle Clamps hold securely—speed production!

FOR MORE FACTS
WRITE FOR TEMPLATE SET AND CLAMP CATALOG

YOU CAN DEPEND ON DE-STA-CO

DETROIT STAMPING COMPANY
350 MIDLAND AVENUE
DETROIT 3, MICHIGAN

Circle 161 on Reader-Service Card

components prior to system assembly is of primary importance. Dust-free areas, dust- and lint-free clothing, rubber or nylon gloves, socks worn over the shoes, and special lint-free material used for wiping or cleaning of parts—all assist in reducing contamination during the assembly of individual components.

Martin-Denver provides an inspection team which regularly checks vendors for adherence to required cleaning specifications. Martin approval is required before any contamination-sensitive component can be used in ground support or airborne equipment. This inspection team operates under quality control auspices and has been a factor in the controlling of contamination.

Future Test Programs

Additive control appears to warrant a great deal of merit. Test programs are being initiated in conjunction with the base fluid of MIL-H-5606A as to lubricity, spring rate, viscosity change and increasing filtration properties under varying temperatures.

The flushing methods presently used appear to be inadequate. A program under investigation considers the possibility and advantage of hydraulically pulsating the systems before and after jumpering the system components. This may facilitate removal of contaminants lodged in crevices, ledges and dead-end holes.

Abstracted from a technical paper, "Hydraulic Fluid Contamination Sources—Their Recognition and Control", presented at the 16th Annual National Conference on Industrial Hydraulics, held in Chicago, Ill., Oct. 20 and 21, 1960.

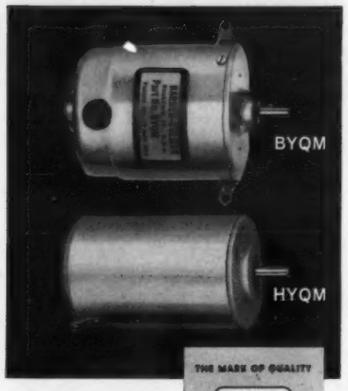
TABLE 1
HYDRAULIC FLUID REQUIREMENTS

SYSTEM	BASIC SPECIFICATION	PARTICULATE CONTAMINATION		
		PARTICLE SIZE	NO. ALLOWED PER 100 ml (MAX)	MAX. FILTERABLE SOLIDS FOR 100 ml[2]
Airborne & Ground Operational Equipment	0–25 microns MIL–H–5606A or MIL–H–6083B	Unlimited 25–100 microns Over 100 microns	Unlimited 250 10	2.0 mg
Ground Support Equipment	MIL–H–5606A or MIL–H–6083B	0–40 microns 40–100 microns Over 100 microns	Unlimited 750 80	3.0 mg

NOTES:
1. Filterable solids are those particles retained on a type AA millipore filter disc, or equivalent. This limit exercises control over the total number of particles allowed in a sample.
2. Three successive samples meeting these criteria shall be taken at fifteen to twenty-minute intervals in order for a system to be considered acceptable.
3. After use, the viscosity of the hydraulic fluid may diminish to a minimum of 8.0 centistokes at 130±5F.
4. Filters used in airborne, ground operational or test equipment must be constructed with metallic filter elements.

Fig. 2

Barber-Colman battery-operated d-c motors with integral governors



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Type BYQM, top, is inexpensive, yet of excellent quality to meet consumer demand for dependability in mass-produced goods. Type HYQM is an exceptionally fine-quality battery-operated motor for the more demanding applications such as portable dictating equipment.

BYQM-Typical Specifications

Voltage range.....approx. 3 to 30
Governed speed.....1200 to 6000 rpm
Torque.....0 to .20 oz-in.
Diameter.....1.29"

HYQM-Typical Specifications

Voltage range.....4.5 to 30 volts
Governed speed.....1500 to 5000 rpm
Torque.....0 to .20 oz-in.
Diameter.....1"

TYPICAL APPLICATIONS

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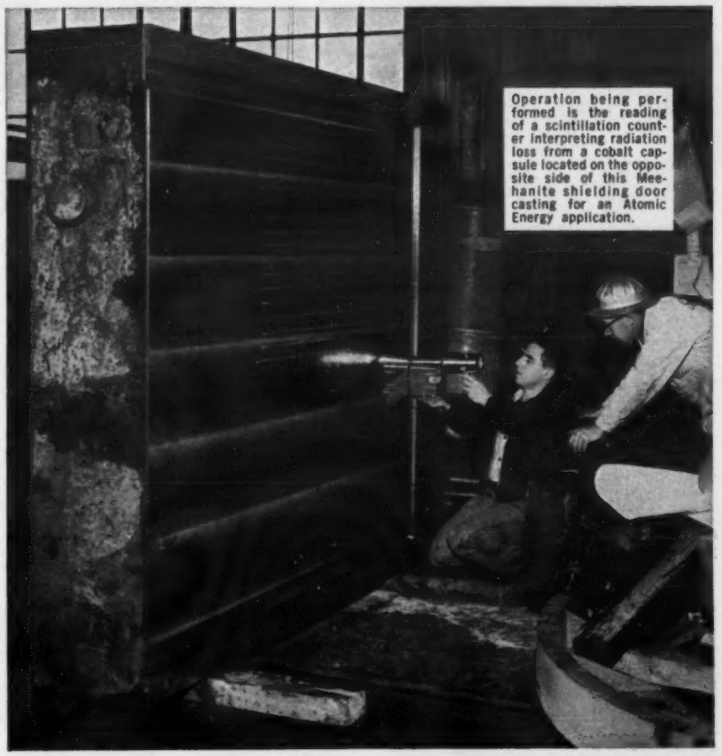
Operation being performed is the reading of a scintillation counter interpreting radiation loss from a cobalt capsule located on the opposite side of this Meehanite shielding door casting for an Atomic Energy application.

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Dimensions of the 85,000 lb. Meehanite casting above are 12'6" x 12'6" x 12" thick. Specific gravity tests, ultrasonic and radiation loss readings verify its uniform and controlled density.

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Evolution Versus Revolution

**Carl Kayan, Professor,
Dept. of Mechanical Engineering,
Columbia University, New York, N.Y.**

The debate on proposed conversion of the U.S. to the metric system has gone on for many decades. Fifty years ago, comparatively, the changeover would not have been so frightening, but it was rejected. The problem continues to be elusive. Perhaps this has been because the solutions hitherto have been so uncompromisingly drastic—solutions that might be effected if rule by proclamations was substituted for "voluntary" action. And well might it be debated that adoption of the metric system is absolutely essential for international trade; convenient, yes, really "essential", open to question. Herein the engineer, with his recognition of technology versus economic realism, must play his role—that of accomplishment and achievement even in standing between the "status-quo do-nothing" group on one side and the ardent conversion-at-any-price disciples on the other.

Operation SCUDS

An objective approach to the resolution of the national problem was initiated at the second symposium on units at the Chicago meeting of the AAAS in December 1959. The general program was entitled Operation SCUDS: Simplification, Clarification, Unification, Decimalization, Standardization. It identifies two main phases of the problem, inter-related of course, but nevertheless distinct. These are: (a) the consumer-public aspects and (b) the technological aspects.

Consumer-public aspects: Operation SCUDS focused attention on the outmoded needless complexity represented in the U. S. system of weights and measures, containing many sub-units tediously learned as children, rarely used and generally forgotten. It drew attention to the unit confusion contributed by our widespread use of the common fractions (called vulgar fractions abroad).

Decimalization ultimately would be

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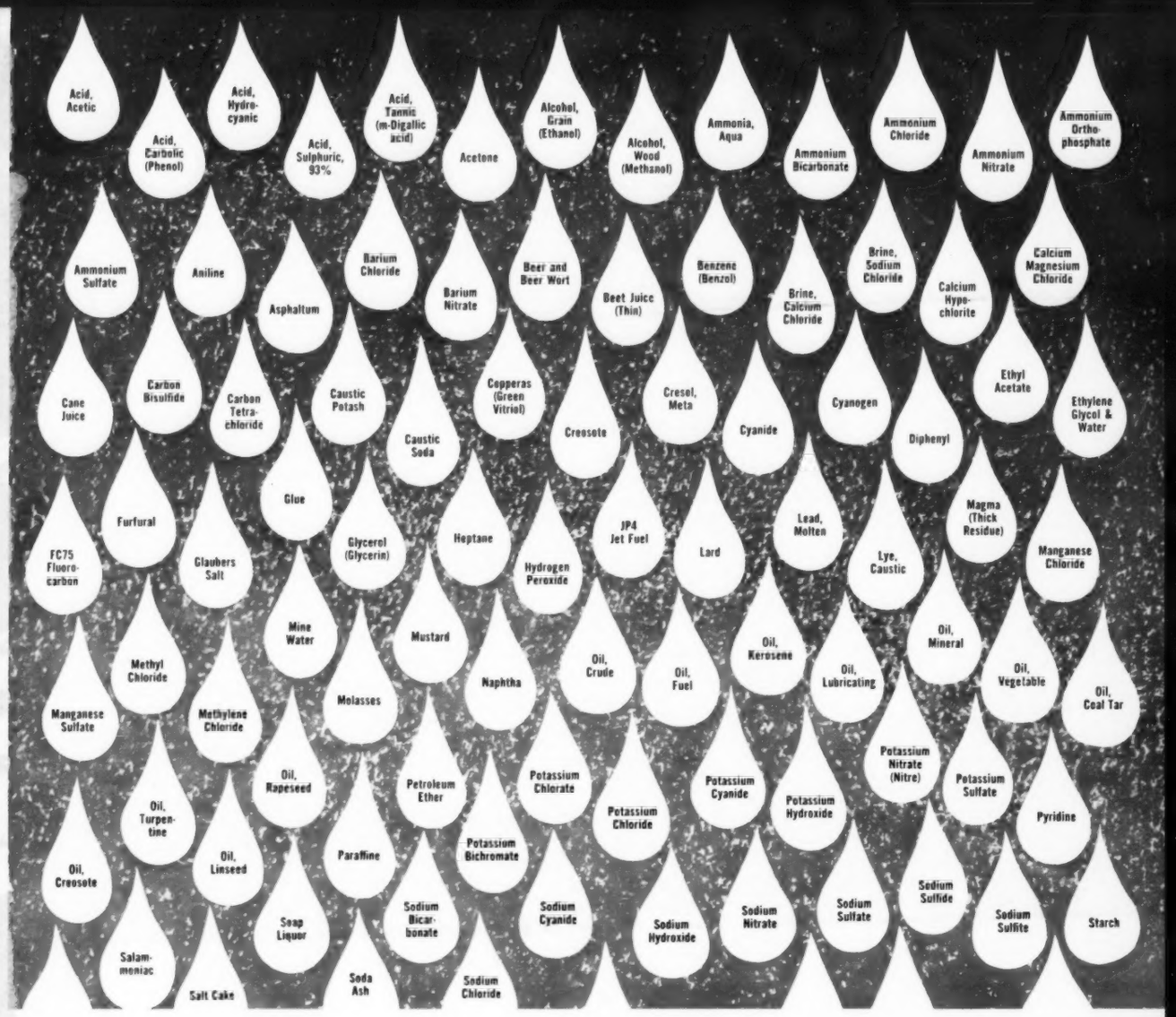

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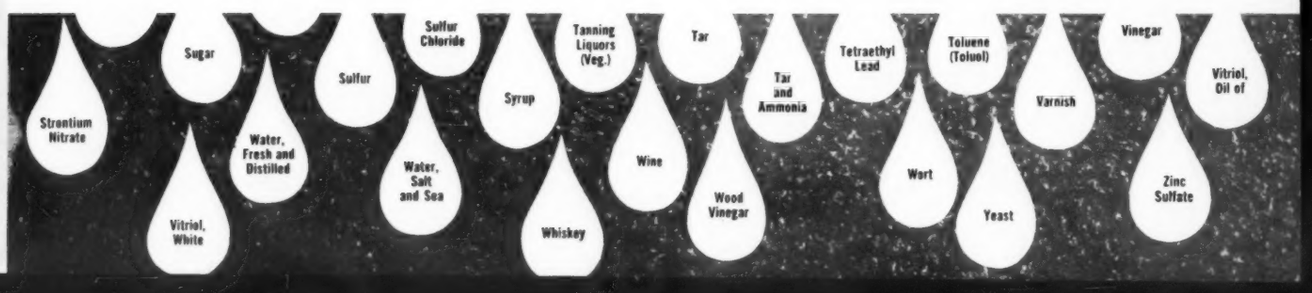
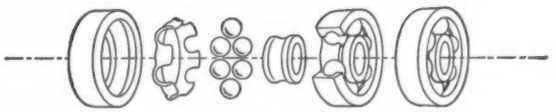




MEASURING ROUNDNESS OF INSTRUMENT BALL BEARINGS

By **RICHARD E. AMIDON,** *Staff Engineer, Production Engineering Department*
New Hampshire Ball Bearings, Inc.

Roundness of instrument ball bearings is a variable not covered by ABEC standards. Yet, it is an important factor in running quality. Since it is a very difficult variable to measure, except with costly equipment, most users must accept roundness on faith.

Roundness can be defined as "equidistance of all points on a curved surface from a fixed center". To measure roundness of a ball bearing component, therefore, you must establish its center and radius. However, since its center is not accessible as a point of reference, you must establish an "artificial" center. The closer the assumed or artificial center is to the actual center, the more accurate a given method of roundness measurement will be.

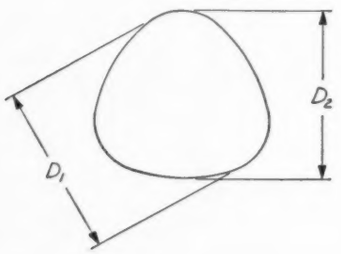
What you're really measuring is out-of-roundness, or deviation from a true circle. Such deviations are called lobing. There are three common ways of measuring out-of-roundness.

THE TWO-POINT METHOD

Most widely used of all measuring techniques is the method of measuring various diameters between two anvils as in a micrometer or two-point gage. The difference between the largest and smallest diameter is out-of-roundness. This method is accurate only if there is an even number of lobes of equal height and symmetrical spacing. Notice in the accompanying sketch of a three-lobed shape, all three diameters are equal . . . and the two-point method would indicate perfect roundness.

THE THREE-POINT METHOD

When an odd number of lobes exists, a three-point gage can be used to measure out-of-roundness. Variations are measured by rotating the part between two fixed points at a known angle with each other and a movable point connected to an indicator. This method, which calls for calculations to convert indicator readings to true-out-of-roundness, is accurate only when the number of lobes is known and they are symmetrically spaced and equal in height.



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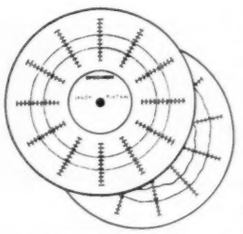

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Fortunately for you, instrumentation has been recently developed which measures out-of-roundness directly as radial variation with accuracy to several millionths of an inch. The part to be measured is chuck-mounted to a precision spindle and slowly rotated. An electronic gage head translates radial surface variations into a polar chart trace with deviations magnified as much as 10,000 times. Comparison of the chart trace with concentric circles of known radii reveals absolute deviation from a true circle. New Hampshire Ball Bearings, Inc. was the first to use this instrument as a quality control tool in the laboratory and on the production line. Other instrumentation used to assure the running quality of New Hampshire Bearings is described in our new Design and Purchasing Manual.

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truly the first step toward an ultimate adoption of a metric system. It could, in the meantime, make our own everyday life a whole lot simpler.

De-emphasized study of tedious common-fraction arithmetic with its dubious later-life compensating use and the earlier teaching of decimals (following, somewhat, European lines) might well go a long way toward making our younger pupils less prejudiced against "mathematics" and science.

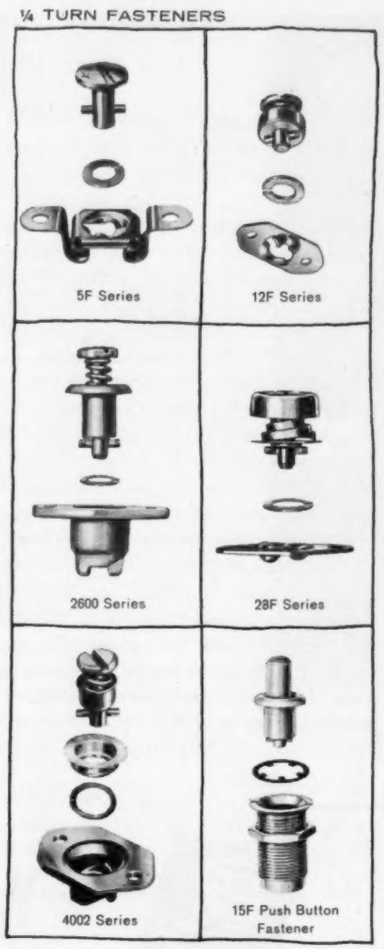
Decimalization of inch dimensions in industry, particularly in mechanical-engineering and machine-shop processes, is already well under way, strongly entrenched. This is a step in the right direction and hardly to be reversed; the "grass-roots" public approach can integrate with it. Likewise, computer use is inspiring decimalization programs elsewhere in industry, for example, in general weighing and volume-metering operations.

Such has been the objective of Operation SCUDS, unit-wise, with its secondary impact on the nation's elementary-school program. It is in this latter realm that a direct contribution can be made, to strengthen the nation's fiber, albeit in the face of a lethargy spawned by the persistence of past customs, early training and habits.

Technological aspects of the unit problem: Pure science long has been accustomed, internationally, to dealing with a metric system. Specifically it has been the CGS system, based on the "absolute" philosophy and employing the centimeter and the gram—decimal subdivisions of the standard units of meter and kilogram. On the other hand, applied science—engineering, has largely been in terms of the gravitational system. This uses, as one of its basic units, kilogram-force in the metric and pound-force in the English operations.

One of the outstanding unit-systems is the MKSA system. It is truly an integrated absolute system of the metric group, derived from the full standard units of kilogram-mass and meter, and accounting also for electrical units. The formal units are meter, kilogram-mass, second and the electrical ampere. Energy, whether in mechanical work or thermal form, is specified in the same terms, namely in joules (10^7 ergs) or in watt-seconds. Energy-rate thus follows as watt (joule/second) or as decimal multiples thereof such as kilowatt or megawatt. These terms are well known to engineers in conjunction with their general association with electrical power. Thus, for a thermal machine doing work, there is a direct comparision in terms of energy-flow rate or power, of kilowatt output versus kilowatt input, representing thermal efficiency. The term "horsepower" is not used.

Summing up, truly, recognition of the many problems is necessary in order to appreciate the



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Evolution Versus Revolution . . . *Cont.*

magnitude of a changeover policy for the U. S. Accordingly, a program of action is herein proposed for the U.S. as its part in paving the way for progress.

Consumer-public aspects: (1) decimalization of the pound and of the inch, with elimination of tedious mixed measurements; (2) revision of the elementary-school arithmetic programs and development of new national arithmetic using decimal values; (3) elimination of the ambiguous terms, such as the gallon and the hundredweight, and (4) expansion of the use of metric terms in common use.

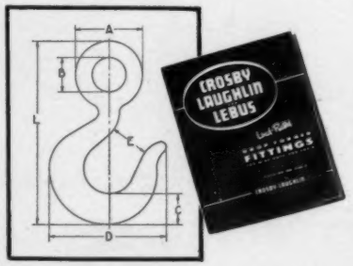
Technological aspects: (1) gradual introduction of universally understood watt (kilowatt, megawatt) for energy rates, with elimination of the horsepower, refrigeration "ton" and similar items; (2) revision of the teaching of engineering mechanics in the U.S., with emphasis on the use of the absolute-system philosophy, based on mass as a basic unit and force as a derived unit, rather than on the gravitational system using force as the basic unit along with gravity-dependent weight; (3) development of dimensionless presentation of experimental data, with citation of basic reference values in a variety of unit systems, and (4) promotion of "bilingual" and "duophilosophic" operating skills in varied unit systems for those "intellectually elite" engineers working in the international "engineering sciences". This particularly includes the MKSA system.

Conclusion

Such is the eight-point program which your author is advocating for the U.S.

This proposed program for the U.S. is planned as constructive progressive action to resolve the chaos and confusion, although the ultimate achievement of a world-wide universal unit system may be far off. Evolution rather than revolution will bring about successful improvement so woefully needed, with lasting, far-reaching benefits.

Abstracted from a technical paper, "Evolution versus Revolution"; SAE No. 287A; $.75; to SAE members, $.50. Society of Automotive Engineers, Inc., 485 Lexington Ave., New York 17, N.Y.



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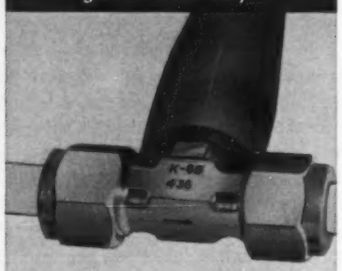

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THE PERFORMANCE OF GYROSCOPES IN A VIBRATION ENVIRONMENT; *W. E. Fellows, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.; ASME No. 60-WA-246; $1; to ASME members, $.50.*

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SOME ASPECTS OF BOUNDARY LAYER TRANSITION AT SUBSONIC SPEED; *Itiro Tani, University of Tokyo, Tokyo, Japan; presented at the Second International Congress, International Council of the Aeronautical Sciences, Zurich, Switzerland; printed by Pergamon Press Ltd., 4 & 5 Fitzroy Square, London, W. 1, England.*

Results of experimental investigations carried out by a research group in Tokyo concerning the instability leading to transition in three types of laminar flow: the wake behind a flat plate, the boundary layer along a flat plate with artificially introduced streamwise vortices and the boundary layer along a concave plate. Attempt is made to obtain a unified conceptual picture of the development of laminar instability.

A DIRECT METHOD OF COMPENSATING LINEAR FEEDBACK SYSTEMS; *Franco Mariotti, Hewlett-Packard Co., Palo Alto, Calif.; AIEE No. 60-1187; $1; to AIEE members, $.50.*

Description of a new method of direct synthesis of a series compensator for a linear feedback control system. The procedure permits the designer to satisfy simultaneously specifications on the location of the complex closed-loop poles and on steady-state behavior, taking into account constraints on the open-loop pole and zero configurations.

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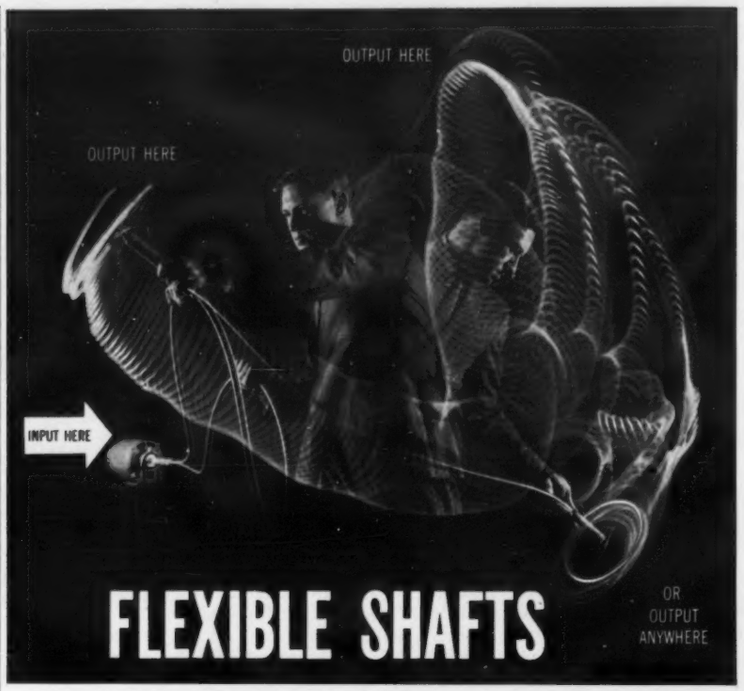

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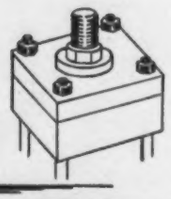

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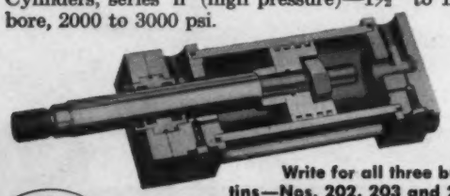

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DESIGN IDEAS NEWS

CONTROL SYSTEMS

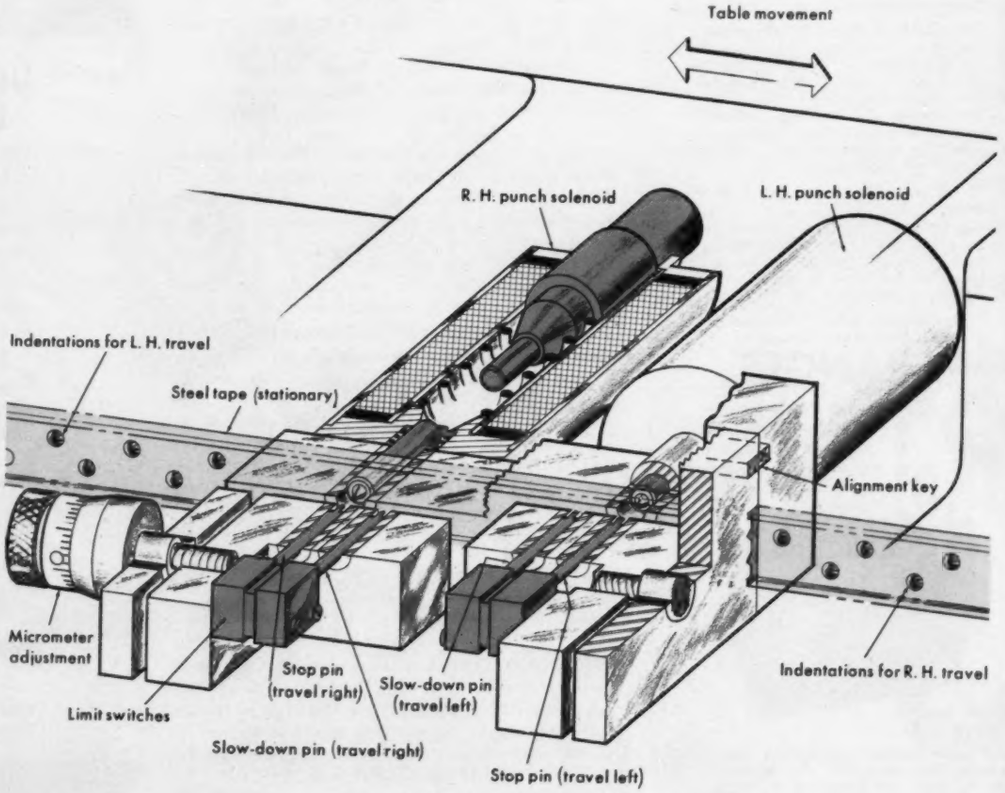
Steel Tapes Position Drill Press Table for

Robert L. Candlish, Detroit Editor

Two removable steel tapes serve as X and Y coordinate records to automatically position a drill press table for repetitive production of parts. Also, at each table position, a program form gives the operator the necessary tool and speed feed information. Powered, rapid and slow approach traverse of the table is provided on both axes by electric motors driving either high- or low-speed gear boxes through electric clutches. The table position is also adjustable by graduated handwheels.

In initial operation, the table is positioned by the operator by combination of power feed plus manual adjustment. Push-button control then causes power indentation of the steel tapes to record the table position and the machining operation is performed. On subsequent machining of identical parts, the table is positioned automatically by sensors probing the indentations on the steel tapes. The table will move simultaneously in X and Y directions to the new position. Position is indicated by "X" and "Y" dials.

The Drilling Information Center located at front eye level contains the operator prompter form and advance mechanism as well as the table and machine controls. The prompter is advanced by push button when the table is repositioned.



TAPE CONTROL STATION has indentor and sensor systems for each direction of travel of table. Indentor mechanism is solenoid assembly with spring-loaded core. Energizing solenoid strikes punch, producing indentation approximately 0.025 inch high on tape. Sensor assembly consists of slow-down pin and stop pin, each backed up by limit switch. Contact of slow-down pin with indentation in tape switches table drive from high-speed clutch to low-speed clutch. Stop pin contact energizes brake and de-energizes motor, stopping table.

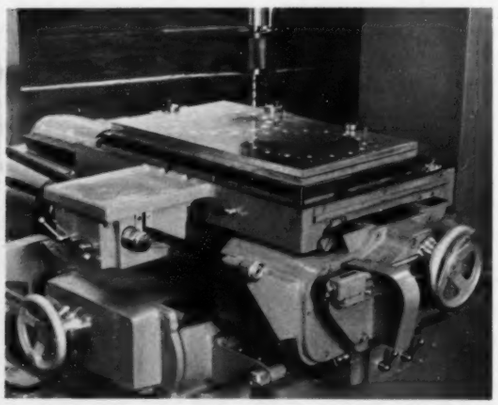
Semi-Automatic Operation

Automatic positioning is direct-acting through limit-switch control of electric clutches controlling the table traverse drive. There are no electronic circuits in the control. Tape-coding machines are not required.

After completion of the job, tapes can be removed from the table and stored. They may be reinstalled readily on the machine should additional identical parts have to be made.

The drill press with automatically positioned table is made by Sibley Machine & Foundry Corp., South Bend, Ind.

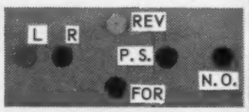
DRILLING MACHINE has gray iron top frame, column and base. Operator prompter form and all controls for repetitive operation are located in Drill Information Center. Drill speeds are infinitely variable from 70 to 2500 rpm. Depth is controlled by preset limit switch. Motors to 5 hp are available. Maximum swing is 40 inches.



DRILL TABLE TAPE CONTROL STATIONS straddle coordinate tapes. Digital counters plus graduated dials on handwheels indicate table position to 0.001 inch.

33	X	Y	SPEED	FEED
	10.875	6.500		
	21/32 Drill through 3/4 – 10 Tap		550 300	0.012

34	X	Y	SPEED	FEED
	14.250	7.875		
	Same as Op. 33			



OPERATOR PROMPTING PROGRAM FORM to instruct operator is prepared by process man. Operation member refers to table position. "X" is left-right axis, "Y" is forward-reverse axis. P. S. indicates tool or speed-feed change required to complete operation. N.O. shows no change required. Form is perforated so when mounted in Drill Information Center, back-up lights indicate necessary steps to complete operation. Form is centered automatically in window on advancing.

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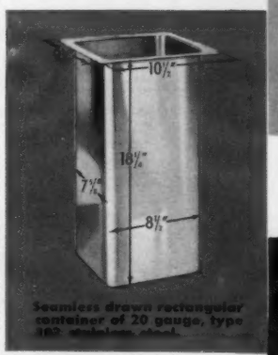

Seamless drawn rectangular container of 20 gauge, type 302 stainless steel.

Seamless drawn oval container of 20 gauge, type 302 stainless steel.

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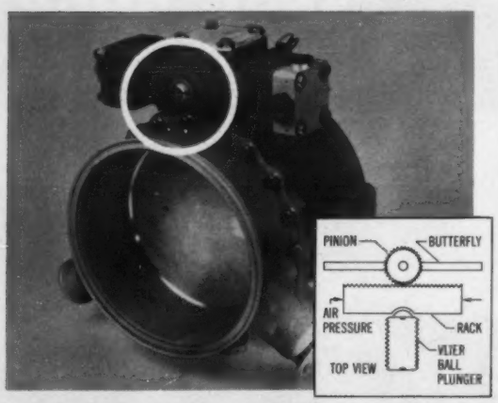
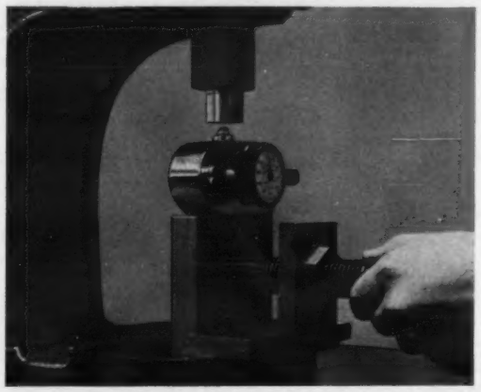
Practical Design Tips

No. 6 of a series

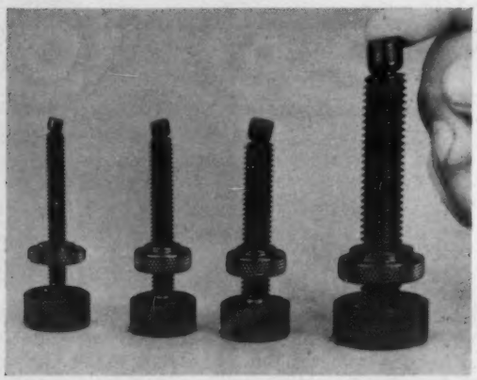
If the profit squeeze is making you look for new ways to reduce costs, look into Vlier products such as those shown below. Hundreds of companies are using these simple, standard parts to replace complicated, specially-machined devices—usually at a fraction of the cost.



SPECIAL VLIER BALL PLUNGER used on this Hermetic Barrier Valve detents on a rack which controls a pinion, which in turn, operates the butterfly. Air pressure forces rack out of detent, opening or closing valve. Plunger, therefore, acts as a positive stop until air pressure is great enough to force shaft past detent. Vlier Ball Plungers are available as standards in sizes from 4-48 x 3/16" to 5/8-11 x 1". Various end pressures. Specials on quantity orders.



SPECIAL VLIER SPRING PLUNGER, shown in test fixture, has laminated phenolic plunger to conform to MIL-P-79B (Type GMG). 1¼" plunger travels .890"; absorbs side load of 105 ±20 pounds. Vlier can provide spring-loaded devices with various diameters, end pressures, plunger lengths, and made of materials to meet your specifications.



NEW CONTROLLED-TORQUE TOOL incorporates a swivel-pad on the screw end to protect surface of part being held. Pad swivel 7½° in all directions to accommodate off-angles. Has unique ball-joint construction for smooth operation. Named the Vlier Torque Thumb Screw Swivel-Pad Clamp, they are available as standards in ¼-20 x 2¼", 5/16-19 x 2¼", 3/8-16 x 2¼" and ½-13 x 3".

FREE IDEA BOOKLET—16 pages crammed with photographs showing how others have profited by designing standard Vlier parts into their products. Your Vlier distributor will be pleased to give you a copy, or if you prefer, write directly to us.

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IDEAS . . .

CONTROL SYSTEMS

Timer's Control-Cam

Victor W. Wigotsky, Eastern Editor

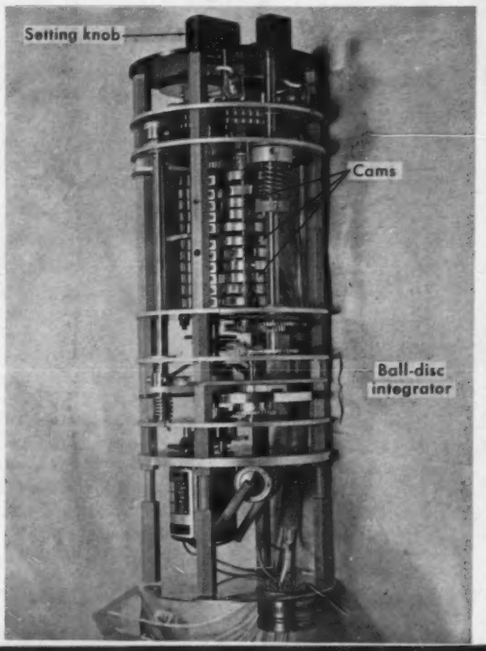
A control cam positions a ball-disc integrator to provide non-linear variable speeds in a de-icing timer. The setting knob on the linearly calibrated dial rotates the cam to adjust a gear segment. Latter then causes sidewise movement of a rack and idler ball to produce the desired speed ratio.

The timer is used in commercial jet airliners to vary duration of de-icing periods in different areas of the aircraft as a function of temperature. This permits balancing of the electrical load.

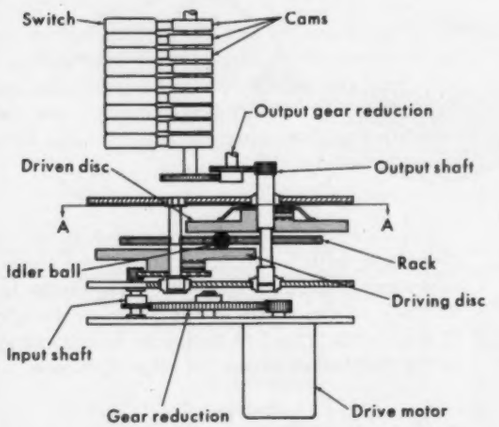
Turning the setting knob—between zero to minus 30C—produces corresponding cam and gear segment rotation. The segment meshes with a rack which carries an idler ball retained between two spring-loaded discs. Since the control cam determines the position of the idler ball, each finite change in cam radius produces a corresponding change in input/output speed ratio. Thus, by using the proper cam contour, desired combinations of linear and non-linear shaft speeds are produced.

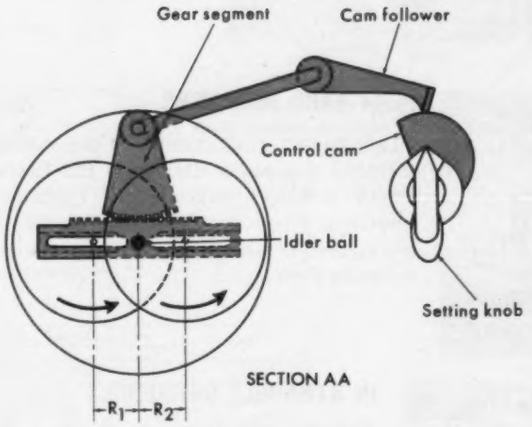
A camshaft assembly is connected to the drive motor through reduction gearing to operate switches progressively for regulation of pulse and cycle times. These can be increased by a factor of two through a scale multiplier on the dial.

The de-icing computer is designed by The A. W. Haydon Co., Waterbury, Conn.



Positions Ball-Disc Integrator





BALL IS MOUNTED ON RACK and moved by direct coupling to setting knob. Control cam, operated by knob, drives cam follower over its generated surface to rotate gear segment and thus change rack position. Design permits non-linear speed variations with a synchronous a-c motor and linearly calibrated dial. Timing range is 24 to 480 sec, with a 48 to 960 range permitted by two-to-one scale multiplier. Building block arrangement makes basic design flexible.

CONTROL

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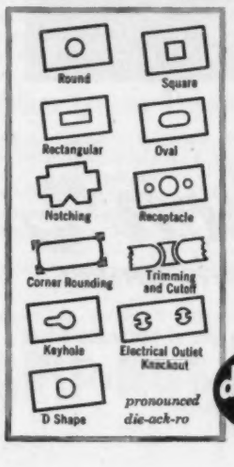

For multiple hole punching ask about the new Di-Acro Adjustable Punch and Die Sets.

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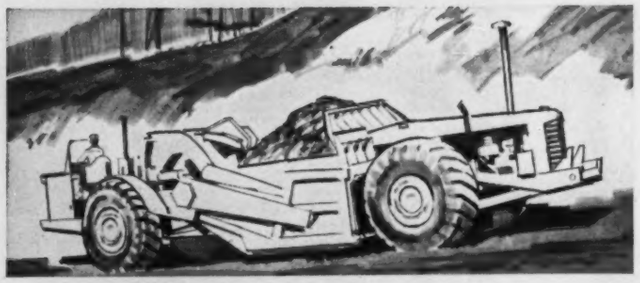
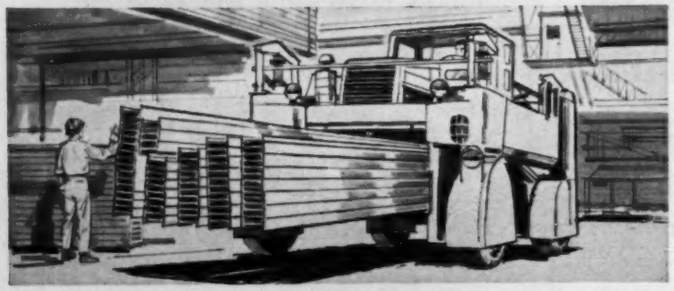


IN 14-YARD SCRAPERS

"Twin Power"—made possible by twin Allison CT-3340 TORQMATIC DRIVES in this Euclid TS-14 scraper—makes every operation smoother. Production is as much as 100% higher, cost per yard 50% less, than for scrapers pulled by tractors.



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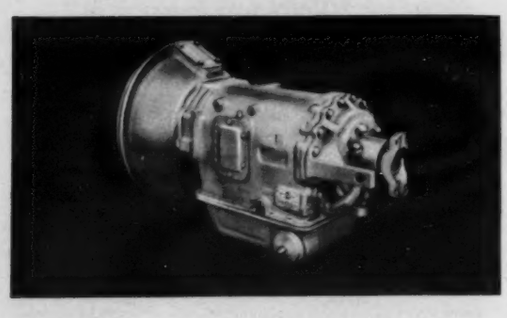

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IDEAS . . .
CONTROL SYSTEMS

SCR Gating Varies

Edward W. Schrader, Western Editor

A silicon-controlled rectifier (SCR) and an inductance vary the voltage to a two-phase servomotor, thus varying the drive speed of the system. Two silicon-controlled rectifiers, one for each winding, give bidirectional control of a 100w a-c servomotor.

The d-c level of feedback from a tachometer, in conjuction with a synchro error-voltage, determines gate position of the SCR. A tap on the inductance to the anode of the SCR permits the SCR to conduct for first half-cycle. Stored energy in the inductance makes the other half-cycle.

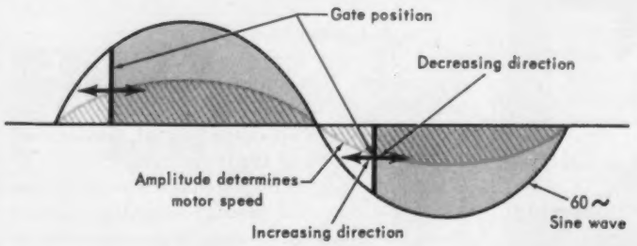
The two-winding control yields a non-linear curve of torque versus applied voltage. The magnetic rectifier control, which applies gating voltage from the d-c tachometer, and the synchro error-voltage, makes the circuit more linear. At null, the gain must theoretically be infinity to prevent sluggishness below the knee of the curve. The device has a 10-millivolt null, thus causing most of the operation to occur outside of the sluggish area of the curve.

Azimuth and elevation inputs are controlled manually. The remotely located controller with the handwheel-driven synchros causes the synchros mounted in the antenna to give an error signal to the control system.

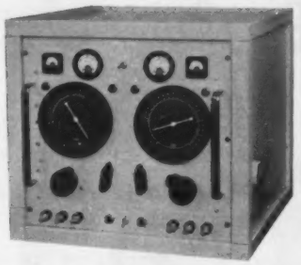
Transistorized pre-amplifier, magnetic control rectifier, SCR and motor drives are all mounted in the portable antenna. The a-c control system and solid-state servo amplifier eliminate moving parts associated with d-c systems, including brushes, commutators and amplidynes. Single phasing of the two-phase motors is prevented by driving both windings of the motors. This gives lower heating of the drive motors during periods of little or no error voltage. Limit switches at the extreme antenna positions connect a diode in series with the windings to give dynamic braking to the system.

The Model 10 Steerable Antenna is a design development of Temec, Inc., Van Nuys, Calif.

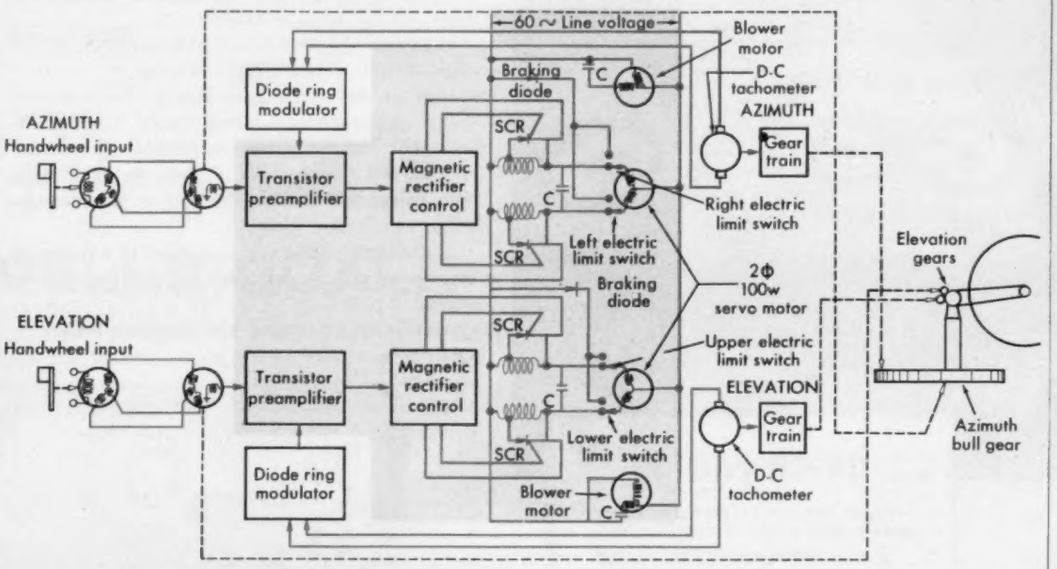
Drive-Motor Speed in Radar Antenna



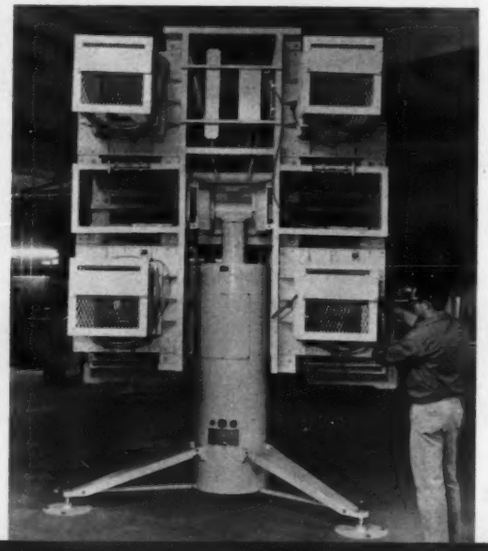
SINE-WAVE AMPLITUDE determines motor speed. This 60-cycle sine wave is Fourier series harmonic of SCR and inductance output as determined by gate position signal from magnetic rectifier control.



CONTROLLER for radar antenna has single switch operation. Each handwheel has slip clutch and inertia load to give operator a "feel" for changing either elevation or azimuth.



ELECTRICAL SCHEMATIC of SCR method for position control system is entirely a-c except for d-c tachometer feedback. Both windings of 100w, two-phase, a-c servomotors are controlled simultaneously by SCR, which in turn is controlled by magnetic rectifier control driven by transistorized pre-amplifier. D-C signal from tachometer enters diode ring modulator to transistorized pre-amplifier driver. Drive motors and SCR control are across 60-cycle, 115v line.



REAR VIEW OF FOUR-HORN ANTENNA. Portable antenna mount is all aluminum. Entire unit including controller weighs 565 lb.

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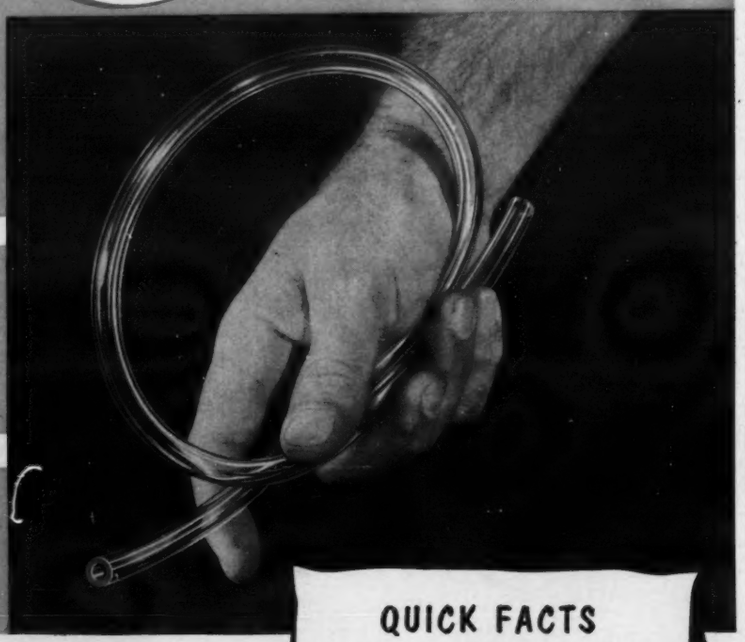

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Flow Transmitter Uses

E. J. Stefanides, Central States Editor

A pneumatic flow transmitter uses a simple arrangement of mutually perpendicular pivoted beams to provide an output signal proportional to the square root of the input signal.

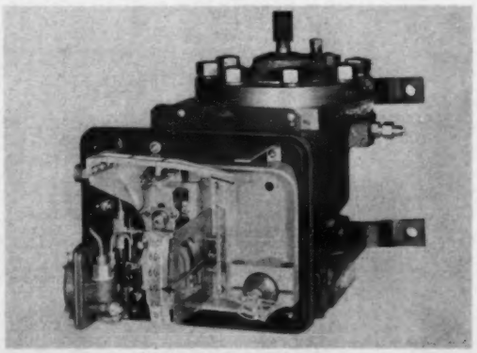
The horizontal beam is connected at the sensing end to a differential pressure-measuring element through a drive link. Changes in pressure differential cause this beam to move vertically in direct proportion to differential pressure. A raised bearing area on the horizontal beam is in contact with a system of flexible vanes arranged in front of a nozzle on the vertical beam.

Movement of the horizontal beam changes the vane nozzle relationship, causing a pressure change in the nozzle line. Nozzle line pressure change is sensed by a spring-loaded booster bellows. The bellows actuates a yoke lever mounted on a pair of flexure discs to open the exhaust or inlet valves and change the output pressure signal as required.

The output signal also is applied to a restoring bellows to provide feedback for rebalancing the system.

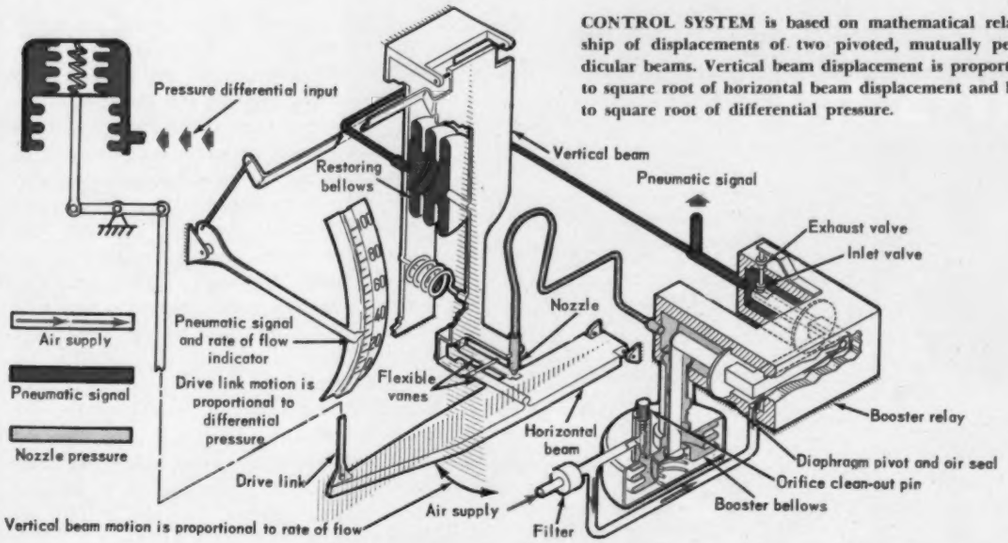
At the cut-off point, the output pressure is again proportional to the square root of the differential pressure input signal.

This device was designed and is manufactured by the Bailey Meter Co., Cleveland, Ohio.



BELLOWS FLOW TRANSMITTER automatically extracts square root of flow differential measurements to produce pneumatic output signal proportional to flow, for transmission to indicating, integrating or control equipment. Device can be used for flow or rate of transmission measurements of liquid or gases between differential pressure ranges of 0-50 to 0-1200 inches of water under service pressures from 800 to 6000 psig.

Pivoted Beam Mechanism to Extract Square Root



CONTROL SYSTEM is based on mathematical relationship of displacements of two pivoted, mutually perpendicular beams. Vertical beam displacement is proportional to square root of horizontal beam displacement and hence to square root of differential pressure.

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The direct-reading spectrometer shown at the left enables us to make virtually instantaneous chemical analyses of all metals produced.

For further information on Wells facilities, write for our descriptive brochure.

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frenchtown engineered ceramics NEWS MEMO

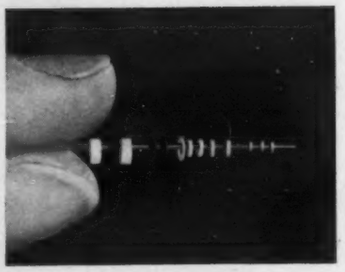
FRENCHTOWN PORCELAIN COMPANY • FRENCHTOWN, NEW JERSEY

Extremes in size shown by Frenchtown Products

The widest range of diameters in the alumina ceramic industry is demonstrated by two ceramic products currently being made at Frenchtown. Take, for example, the huge cylinder used in hydrogen fusion experiments within the C-Stellerator at Project Matterhorn, Princeton, New Jersey. Measuring 21" O.D. by 16 1/2" I.D. by 66" long, fired, this tube is produced by casting in plaster molds. A cycle of over 10 weeks is required from the preparation of mold until the ware is removed from the

kiln. Weighing over 1500 pounds, these rough castings are believed to be the largest ever produced in aluminum oxide ceramics. Subsequent diamond grinding to precise final dimensions consumes another 8 weeks.

Contrast the above with miniature semi-conductor packages, measuring .050" O.D. by .030" I.D. by .010" thick, numbering 600,000 pieces per pound. Both are made from the same

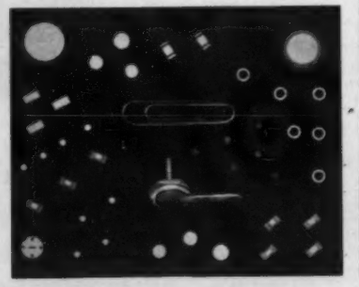


alumina ceramic material, Frenchtown's well-known #4462 Almanox.®

If you would like to investigate how Frenchtown engineered ceramics can make your product better, write stating your problem. A blueprint or sketch with specifications will bring complete information.

Beryllium Oxide Ceramics now offered by Frenchtown

Combining excellent electrical properties with high thermal conductivity, Frenchtown beryllium oxide ceramics are available in molded and extruded shapes. An extensive series of compounds with beryllia contents up to 95% affords the user a wide choice of properties, including great mechanical strength.



Frenchtown's Molcote® metallized coating may be applied to selected areas for subsequent assembly with metal parts through brazing or high-temperature soldering. Nickel, copper, gold and other plated metals are applied over the Molcote® as specified.

Demand for beryllium oxide ceramics as semi-conductor packages indicates a widespread acceptance of this material for use where heat-sink function is coupled to that of electrical insulator. Nuclear instruments and control apparatus also make extensive use of beryllium oxide's unique properties. A Frenchtown Sales Engineer would be happy to discuss specific problems with you involving the use of these versatile ceramics. No obligation, of course.

Semi-conductor Package Ceramics by Frenchtown

Headers, pads, cases, mounts, and other semi-conductor package items are being supplied by Frenchtown. Available in aluminum oxide and beryllium oxide ceramic materials, these specialties are offered either plain or metallized. Frenchtown's Molcote® metallized coating can be applied to specified areas for ceramic-metal assembly by brazing or high-temperature solder. Complete packages, including lids, bottoms, leads, and other metal parts are produced to order.

Of special interest are diode mounts with beryllium oxide pads, providing excellent heat-sink characteristics, combined with electrical insulating properties. Literature is available. Ask for Bulletin 1060.

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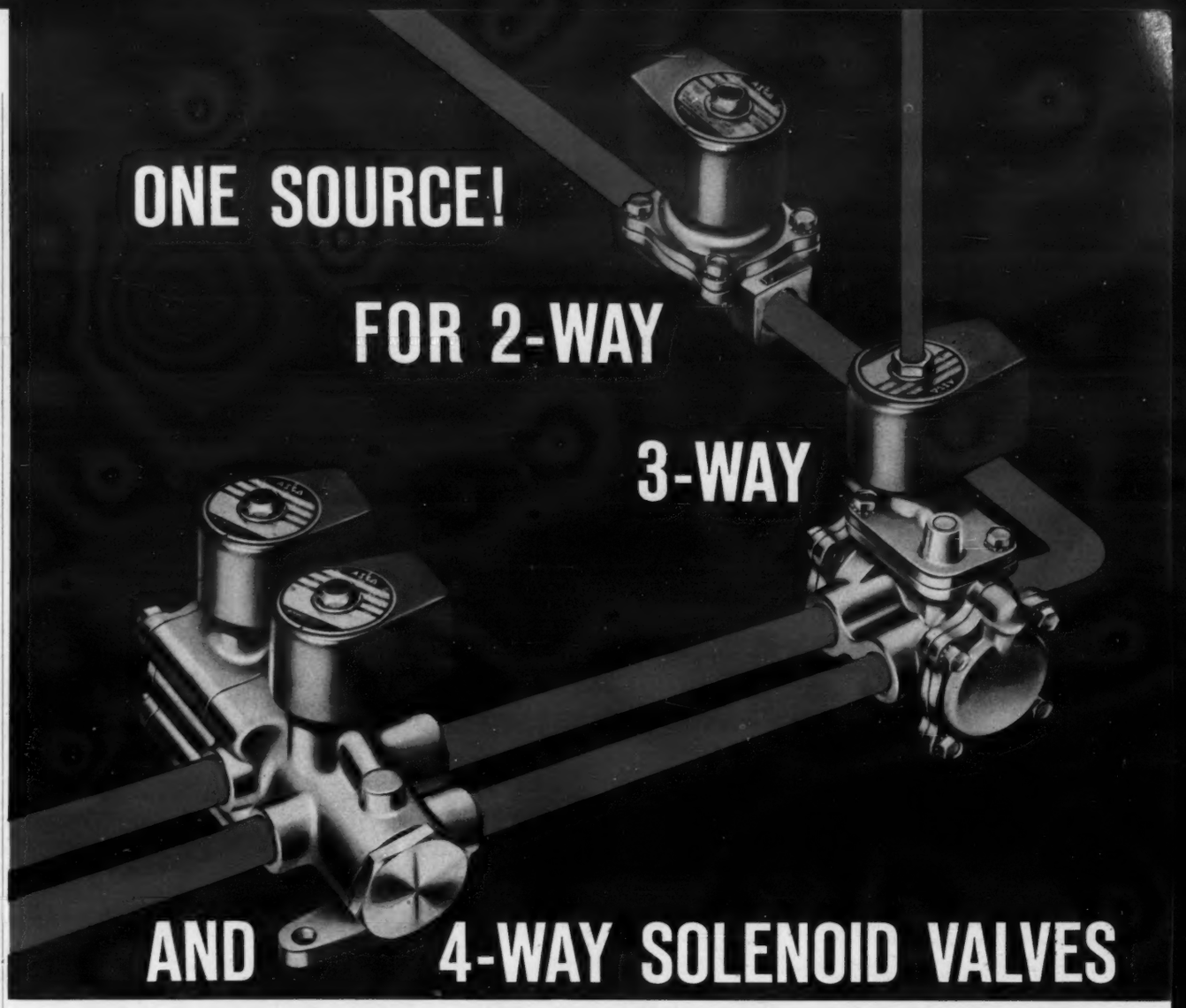
NEW BOOKS

BASICS OF ANALOG COMPUTERS. Printed in the typical Rider fashion of pictures and text, this is really three books in one. It is the first comprehensive work on analog computers capable of explaining to almost anyone the basic principles involved, as well as their practical application. First of the books-within-a-book introduces the concept of analogs and the simply-stated mathematics for computing using analog functions. The second volume pays particular attention to analog computer types and d-c analog electrical functions involved. The third volume covers feedback systems as applied in industry. A glossary of terms completes the work. This is a good companion text to a similar three-volume book by the same publisher on digital computers. Of particular interest are some of the illustrations which show mechanical and hydraulic analogies for the electrical computers described later. The entire course is bound in a single hard-cover binding. By Thomas D. Truitt and A. E. Rogers; John F. Rider Publisher, Inc., 116 W. 14th St., New York, N. Y.; 400 pages; $12.50.

INTRODUCTION TO ENGINEERING COMPUTATIONS. The intent of this book is the efficient and orderly handling of the tools and techniques of engineering computations. Because the work is intended for study in first-year engineering and science, it will be of value to many working engineers who have found their training unsatisfactory or who have forgotten significant aspects of handling computations. The book emphasizes that computations are not merely mathematical manipulations, but rather a method of communication important in the solution and interpretation of engineering work. Discussions of construction and use of the slide rule are included as an integral part of the book, as a means of showing "why" as well as "how". Significant Figures are discussed, along with such topics as Maintaining Proper Precision in Arithmetic Operations, Propagation of Errors, and Number of Significant Figures. One complete chapter is devoted to the subject of Empirical Equations. Additional subjects covered include Alignment Charts, Graphical Representation and Preparation of Technical Reports. By Charles M. Fogel; International Textbook Co., Scranton 15, Pa.; 210 pages; $6.50.

SMALL PLANT MANAGEMENT, Second Edition. "To get useful work done in the most systematic way, is the know-how meaning of all operating that is undertaken by any enterprise." This sets the tone for one of the better management books to appear for quite some time. Each of the chapters is devoted to problems of specific interest to small plant owners and managers. In the small plants of today, or all plants for that matter, the problem of high cost and low profit margin is of ever-increasing importance. The topics discussed contribute to the solution of this problem in some way. Of vital interest to the small plant manager are: Financing and Banking; Government Interest in Small Plants; Top Management Planning; Fulfilling Legal Requirements; Unions; Productivity; Technical Research; Taxes; Savings and Profits. The Small Plant Committee of the American Society of Mechanical Engineers has, in one volume, presented the work of experts in the areas of economics, the job of management, solving small plant management problems and the small plant of the future. The book shows how managers, by applying know-how operating, can create best performance by using a kind of management that brings machines, methods and men into the best combination. Those who are planning business ventures for the first time, and those who are now in business management, will find this book a significant contribution to their reference library. Prepared under the auspices of the Management Div. of the American Society of Mechanical Engineers; McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y.; 563 pages; $10.50.

Circle 183 on Reader-Service Card



When you discuss solenoid valve requirements with an ASCO engineer, you benefit from the design and development experience of half a century. The ASCO specialist can recommend the right valve for your needs because ASCO pioneering has brought about the thousands of types of solenoid valves now available:

Two-way valves in pipe sizes from ⅛" to 8"—for temperatures from -350°F to 600°F—for pressures to 5000 p.s.i.

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10 NEW PRODUCTS IN THE LAST 5 YEARS

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• **OPTICAL MASER** uses gaseous discharges to achieve continuous operation. The maser receives its energy from an electrical discharge of very low power. The coherent beam of radiation lies in the infrared portion of the spectrum and is thus invisible except through a "sniperscope" or similar converter.

The spectral line width of the output beam is a hundred thousand times narrower than that from other coherent light sources. This property has permitted the observation of difference-signals at radio frequencies between two optical lines.

The gas maser uses a mixture of helium and neon gases through which the electrical discharge flows in the same way as in a conventional neon tube. Energy from the internal discharge excites the helium atoms to a very high upper "metastable" energy level, from which they normally would not radiate energy.

40-INCH TUBE, filled with helium and neon, is heart of optical gas maser. Interactions between gas atoms produce coherent beam of infrared light.

Neon atoms in the mixture collide with the excited helium atoms and the energy is transferred to them through the collision process. The neon atoms themselves then can be stimulated to radiate their energy on demand in a continuous stream. The beam is reflected back and forth through the length of the gas-filled tube by semi-reflecting end plates, growing in intensity with each trip. Some of the beam is transmitted through the plates and forms a very narrow output of coherent infrared light.

During this stimulated radiation of energy, some of the neon atoms also drop into lower energy levels, spontaneously emitting the reddish-yellow light typically associated with normal neon tubes.

The power required to excite the maser action is in the tens-of-watts range. Output power is in the 1/100w range. At this level of operation, the tube is so cool that it can be held in the hand without discomfort. The level of operation can be increased by using larger tubes.

The continuously operating optical maser was announced by scientists at Bell Telephone Labs.

ERIEZ *Magnetic Minute*

60 seconds that will help you improve operating efficiency.

HOW TO BUILD A PLUS INTO MATERIALS HANDLING EQUIPMENT

There's an Eriez Hi-Vi Vibratory Feeder to handle anything from powders to parts, rivets to rocks. If your problem involves feeding bulk materials of most any size, consider including Eriez Vibratory Feeders in your new designs for materials handling equipment.

Versatile, AC operated Hi-Vi® Feeders with 100% range of control, provide accurate, economical performance whether the application requires feeding a few ounces or many tons per hour.

Only Eriez gives you this exclusive combination of advantages: No bulky rectifier needed (AC operation) . . . Simple controls, less wiring and installation time . . . Totally enclosed drive, ideal for hazardous, dusty, wet, or corrosive conditions . . . New fibre glass springs assure superior performance and control, longer life because spring breakage is practically eliminated . . . Rugged construction withstands severe operating conditions.

Choose from many models for light, medium, or heavy-duty applications. For engineering data, write to:

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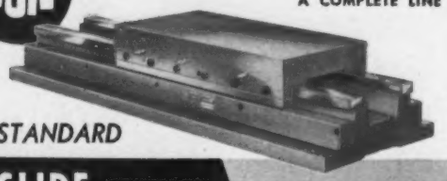
NOW for your SPECIAL machines...

A COMPLETE LINE OF



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SLIDE ASSEMBLIES With Hardened Steel Ways

STANDARD SIZES

- SADDLE WIDTHS of 9", 11" and 15".
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- SADDLE WORK SURFACES from 9" x 9" to 15" x 60".
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Featuring ¼ to 10 amps capacity in postage stamp size, the new "S-8" Klikswitches offer precision repeatability . . . adaptability to any low-force or standard actuator . . . variety of terminals and contacts to suit infinite single or rigid multiple-mounted applications. General Controls developed "S-8" precision on-off switches to save *you* time and money through new availability of complete switching packages from one source.

For complete information check the yellow pages of your local directory for your nearest Authorized Distributor or General Controls Factory Branch Office.

PIC AUTOMATION CONTROLS DIVISION

GENERAL CONTROLS

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• **DISTILLATION PROCESS** for desalting sea water vaporizes the water without either boiling or bubbling. The system features an assembly of revolving blades which operate much like an automobile's windshield wipers. The fresh water produced is salt-free to within one part of salt per million parts of water.

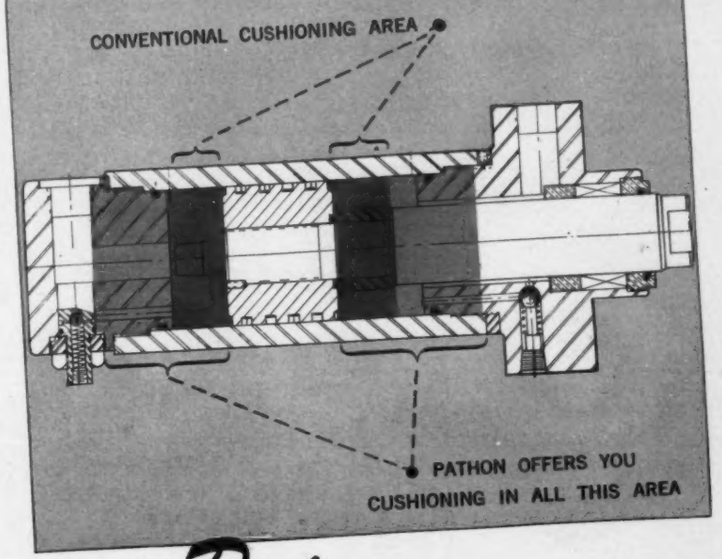
The sytsem can extract 42 lb of fresh water from each 100 lb of sea water used. The evaporator consists of two vertical tubes, one inside the other. Sea water is fed into the wiper assembly where the slowly revolving blades spread the salt water on the inner surface of the inside tube in a film scarcely 1/1000 inch thick.

Heat, produced by steam, is transferred through the walls of the inside tube, causing the salt water to evaporate. Pure water leaves the evaporating chamber as vapor, and the concentrated brine is drained off.

Boiling of the salt water, which could seriously diminish purity, has been eliminated because films of water spread by the revolving wipers are so thin they will not support bubble formation. Bubble-free distillation produces fresh water of exceptionally high purity by avoiding carry-over of mineral particles.

The distillation process was announced by General Electric Co.

NOW! CHOOSE THE CUSHIONING TO EXACTLY FIT YOUR REQUIREMENTS!



Another Pathon *First !*

High speed cylinder operations frequently require more refined deceleration techniques than ordinary cylinder cushions.

Now, Pathon cylinders are available with adjustable or non-adjustable cushions that are three to four times longer than ordinary cushions to provide the effective control required.

This extra length does not increase standard catalog dimensions and you can customs-specify any length or configuration up to the maximum.

Write for "LET'S TALK CUSHIONS" for details.

Pathon MANUFACTURING COMPANY

3823 Pacific Avenue, Cincinnati 12, Ohio

FLUID OPERATED AND CONTROL EQUIPMENT

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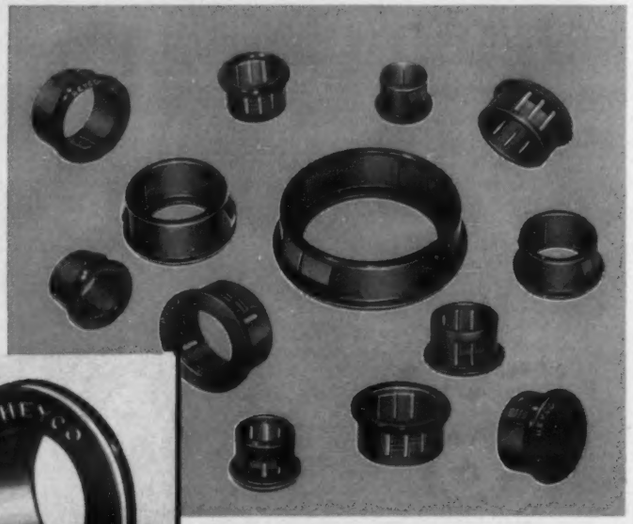
NYLON

Snap Bushings

NEW From HEYCO®



Snaps easily and locks into panels of varying thickness up to ⅛"

withstands 35 lb. pushback test!

Here's a Bushing to meet your requirements

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- Provides complete insulation–it's Nylon
- Approved for temperatures of 302°F.
- Not affected by oil or grease
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USES:
Insulation and mechanical protection for Electrical Wire & Cable, Tubing & Hose, Rope & Cable, Bearing Surface for Moving Parts.

Samples are FREE

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RELEASES...

• **LIQUID OXYGEN CONVERTER** supplies breathing oxygen in high-flying aircraft, saving valuable space and weight. Ten liters of liquid oxygen carried airborne in the converter hold the equivalent of 8,610 liters or 304 cu ft of gaseous oxygen. Gaseous oxygen can be delivered at rates up to 150 liters per minute at an operating pressure of 70 psi.

Of double-wall construction, the converter has a stainless-steel inner sphere and an aluminum outer sphere. The annular space contains a special insulation. Oxygen evaporation loss is two lb per day.

More than 180 lb are saved with the use of the converter which weighs only 44.07 lb when full. An equivalent supply of oxygen in 11 high-pressure cylinders would weigh more than 225 lb.

The converter was announced by Linde Co., Div. of Union Carbide Corp.

TA CASES

a case in point!

Erie–Pacific Digital Interval Timer
Erie–Pacific utilized a TA Standard Case for their digital interval timer realizing a substantial monetary saving while obtaining maximum protection and enhanced appearance.

Be it fire, water, shock or a host of other critical requirements, TA specializes in designing and fabricating standard case lines. We can show you how to utilize any one of our standard cases to house your instrument or product. TA's standard cases are not only far more practical and more economical (about ¼ of what you would normally expect to pay), but you can have them in 2 or 3 weeks instead of the 90 to 120 days usually required for custom cases. If you want to show top management how they can save money and incorporate all the features required in one handsome case, then write TA. For transit cases, instrument cases, combination or storage cases–military or commercial–you can't beat TA.

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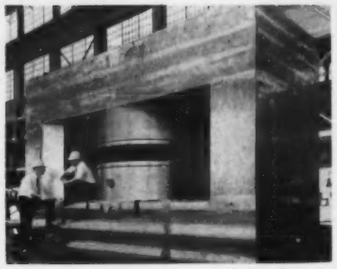

• **MAGNET CORE** of a variable-energy cyclotron weighs an estimated 310 tons. When completed, the cyclotron will have a continuously variable energy rate of 15 to 40 million electron-volts. Built by Bethlehem Steel Co., it will be housed in a new laboratory facility now under construction on the North Campus of the University of Michigan.

Heaviest individual parts in the magnet core are the top and bottom members of the magnet frame, also called the yoke. Each weighs approximately 105 tons. When joined with vertical spanners by large dowel pins and studs, they form a magnet frame measuring 224 inches long, 83 inches wide and 143 inches high. Magnet poles, top and bottom, are located within this magnet frame.

An unusual feature in the design of this cyclotron core is an air gap of ½ inch between pole and pole tip in each of the two poles forming the magnet core. Poles are of the spiral ridge type. This term refers to the shape of the magnetic field inside the air gap. The construction provides a magnetic field with properties that enable the emerging particles to be focused better than with the more conventional, uniform field cyclotrons.

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NICKELOID IS EVERYWHERE

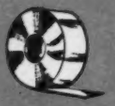
IN THE LIVING ROOM

IN THE KITCHEN

ALL AROUND THE HOUSE

These eye-catching products use functionally a basic Nickeloid Metal. The finish of Chromium, Nickel, Brass or Copper is electroplated to a base metal, usually Steel (but often Zinc, Brass or Copper).

Mostly, Nickeloid Metals are supplied in continuous coils in widths up to 24" for modern, low cost fabrication. They're also available in sheets and strips. Optional: bright or satin finishes, plating one or both sides, a galaxy of stunning patterns and crimps.



Quality plating produces metals so durable they can be fabricated, even quite severely drawn or bent. Rejects minimized. For severe stamping, we offer Mar-Not protective coating that is easily peeled off after its job is done.

Yes, wherever you go or whatever you do, there is an abundance of useful and prized products on which a Nickeloid Metal gleams, front and center, in full spotlight. Their use at once captures a smart, modern beauty that is durable, easy to keep looking new, and chic. But here is beauty that is more than skin deep . . . Nickeloid Metals are versatile, extremely economical in manufacture . . . deep-down in quality all the way. They are the shopkeeper's delight, the manufacturer's friend, and the designer's inspiration. You can *do so much* with Nickeloid! It's more than a Metal . . . it's a *Method!* Write for free Introductory Kit, including metal samples. Or, phone one of our sales offices (located in most principal cities).

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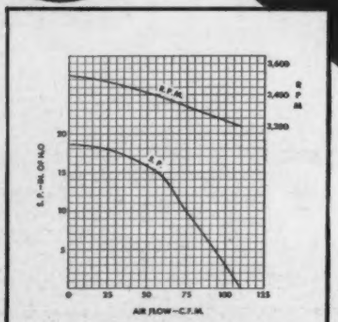
America's Pioneer Manufacturer of Pre-Finished Metals — Since 1898

the pressure's on for '61

MULTI-STAGE BLOWER

60 cps or 400 cps
1φ or 3φ
To 440 Volts
10" O.D. by lengths up to 14"
Ambient Range: —55° + 85° C
Commercial or Military



MULTISTAGE BLOWER
60 cps — 6 Stages

When engineering specifications require continuous duty and quiet long life, Air Marine offers multistage blowers for low volume, higher pressure applications to 1 psi with air delivery to 100 CFM. Featured is long life with low noise. Where high pressure is required or on such vacuum applications as tape retention, the Air-Marine multistage blowers are the efficient answer.

Our field engineers will gladly assist you in the selection and application of motors, blowers or fans.

Air Marine motors, blowers and fans have been designed and tested to meet the specifications of both the military and industry.

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RELEASES...

• **MINIATURE MEMORY DRUM,** spinning indefinitely, can hold up to 358,000 bits of information. Spinning at about 10,000 rpm, it is a key part of a parent computer. The development may contribute greatly to future advances in space exploration by making it possible for a computer to perform aloft reliably for years.

The eight-lb aluminum sphere can store information at 600 bits to the inch. This high capacity was achieved by using "floating heads" to pick up and record data. Instead of being fixed to the drum assembly as are standard heads, these "float" on a film of air one ten-thousandths of an inch above the drum's surface.

Another feature of the drum is its so-called "one-word loop", which speeds computer performance by enabling it to utilize information virtually as fast as it receives it and deposits it on the drum. With conventional equipment, a computer would have to wait for the drum to complete one revolution before "reading" the information it "wrote into" the cylinder.

Long life is achieved through use of air-bearing suspension of the rotor. Air bearings are immune to radiation which could clog the operation of ball bearings.

The memory drum was announced by Sperry Gyroscope Co.

The Story in Back of a Symbol

Begin with a coil for perceiving electrical changes. Add two arrows and convert sensing ability into action. Now, enclose in an ohm ... and you have the signature of the REGOHM® family. These controls, of pure simplicity and reliability, are being used in over a million individual applications throughout the world.

Consider one fast-rising scion of the family tree—the REGOHM Transducer. If you would like to make a mosquito move a mountain, the transducer will bring you close to the summit. A few grams of force causing less than ⅛ inch movement effects direct control at the ¼ kw level.

Performance like this can significantly reduce costs in many control systems: Position, Tension, Weight, Loop, Speed, Pressure and others.

ERC Engineers are ready to assist you with your application. To learn more about the REGOHM Transducer, contact:

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"leaders in automatic control and regulation"

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Gusher Pumps contain no seals, pre-lubricated heavy duty ball-bearings reduce maintenance to a minimum.

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. . . Gusher Pumps are precision built, there is no metal to metal contact within the pump.

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All of us at Ruthman are interested in your business. We want to earn it by giving you the best *service* at *all times.*

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on your machine. Follow the leading machine tool builders; *specify* GUSHER Coolant Pumps.

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Model 110231

THE Ruthman MACHINERY CO.

1804 Reading Road, Cincinnati, Ohio

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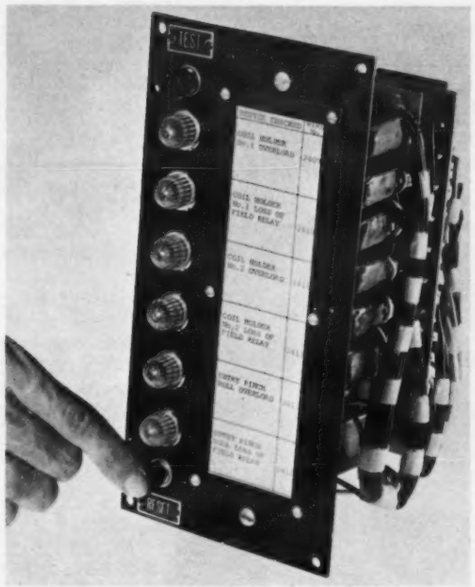


• **STATIC FAULT FINDER** automatically indicates location of faults and malfunctions in electrical control equipment. The design incorporates static magnetic-type switching and memory-type operation. Low-voltage incandescent lamps indicate faults.

Each unit can monitor one to six individual devices. It is composed of six full-wave self-saturating magnetic amplifiers—one for each control circuit device to be monitored. Under normal operation, all indicating lights are held in the "off" state by a bias control winding which keeps each magnetic amplifier in an unsaturated state. Each amplifier also has its own signal winding which shunts a normally closed contact of the device under observation. When a fault occurs (opening of contacts in a device), a voltage appears across the terminals of the signal control winding which tends to saturate the core of the amplifier and provides output voltage to the indicating light.

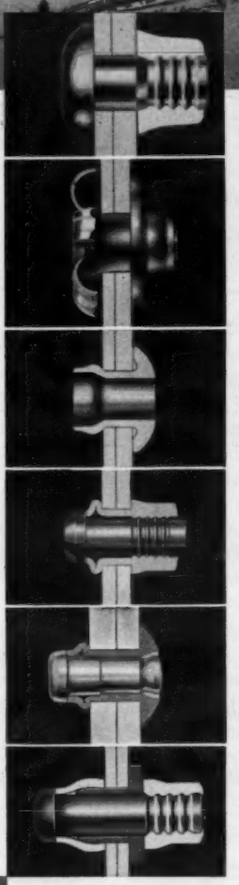
Voltage across the light is maintained by the action of a feedback control winding which will keep the cores saturated should the signal voltage change or disappear.

Because of the memory feature, each lamp remains lighted until manually reset, even though the fault has been cleared. The unit is suitable for detecting open contacts in protective or emergency stop circuits.

The Static Fault Finder was announced by The Clark Controller Co., Cleveland, Ohio.

- FASTER, EASIER INSTALLATION
- GREATER STRENGTH
- UNIFORM TENSION
- MAXIMUM SHEAR STRENGTH
- PRECISION FIT
- LOWER INSTALLED COST

Huck permanent fasteners are available in many types, shapes and sizes, from ⅛" to ¾" diameter, to meet the requirements of all types of manufacturing, from railroad cars, trailers, buses, ships, blowers, appliances, to farm equipment and prefab buildings. These and many other users specify Huck fasteners for reasons of economy, speed of application, strength and dependability. You too, may find the answer to faster, better, cost-cutting assembly by investigating Huck's advantages. Write for literature, or ask for a Huck Sales Engineer who will be glad to explain the advantages of Huck Fasteners in your product. No obligation.



CL— Commercial Huckbolt

DR— Daisy Blind Rivet

PT— Pull-Thru Blind Rivet

OS— Oversize Structural Blind Rivet

MLS — Mechanical Lock Spindle Blind Rivet

BL— Blind Huckbolt

HUCK MANUFACTURING COMPANY

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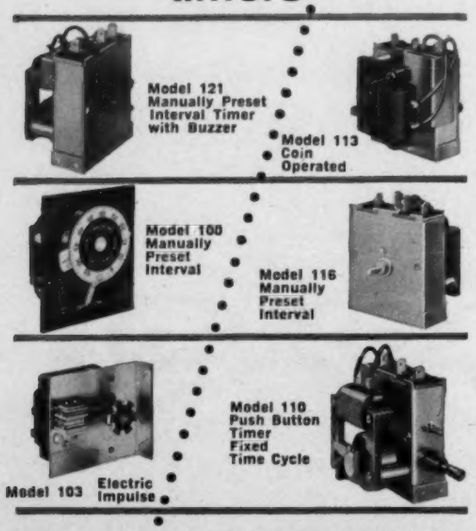
assured with MILLER-HARRIS field-proved timers



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Miller-Harris' reputation is based on two uncompromising facts: quality-made electric control timers, and their *expedient delivery!*

These factors will contribute greatly toward helping you: preserve *your* products' high quality standards, maintain *your* production schedules, meet *your* shipment and delivery dates, fulfill *your* sales objectives.

Get to know more about the Miller-Harris insight into your control problems, product simplification and cost reduction programs.

Whether your control timer requirements are for "standards" or "specials", Miller-Harris can supply your needs exactly and follow through with the delivery service that means complete satisfaction.

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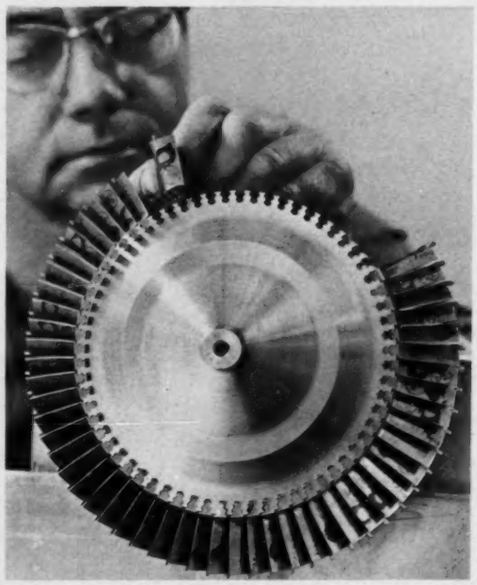
RELEASES...

• **FIR-TREE TURBINE WHEEL** for Boeing Industrial Products Div.'s T50 gas turbine engine is among the smallest fir-tree wheels produced today. Both the 7-inch dia, 66-blade gas producer and the 9-inch, 50-blade power turbine wheels are of this construction.



The turbine wheels, which turn up to 38,000 rpm, were formerly of welded construction. The wheel hub shown is broached from an "Inconel X" forging. Fir-tree assembly will allow replacement of damaged turbine blades. Each blade, made of GMR-235 material, is held in place by a metal key. The Boeing T50 is a 270-shaft horsepower turbine.

• **MILITARY INFORMATION** added to the VSMF (Vendor Specs Microfilm File) includes 23,000 military standards, MIL-D-70327 (vital military drawings) and Military Handbook 300 (ground support equipment for air weapons systems). The information has been filmed and indexed both numerically and alphabetically.

VSMF is an information retrieval and product searching system which is now in use in nearly every major aerospace plant throughout the United States. It was developed by Technical Services, Inc., Denver, Colo.

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Valuable data on wide range of sizes, shapes, designs from stock—and to specs in small bobbins of Nylon, Delrin, Kel F, etc.
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NO MINIMUM SIZE! Maximum sizes:
Zinc Alloy—1¾" long, ½ oz.
Plastic—1¼" long, .03 oz.

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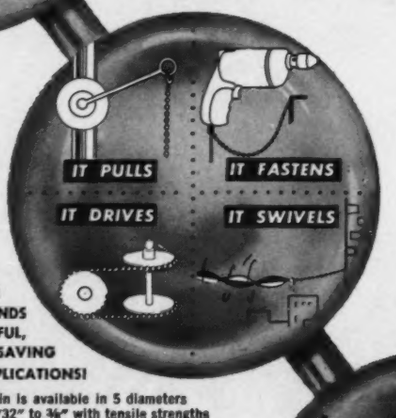

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Bead Chain is available in 5 diameters from 3/32" to ⅜" with tensile strengths ranging from 18 to 200 lbs., in a variety of metals and finishes. No matter what the requirement, our engineers will be glad to assist you in solving your chain applications.

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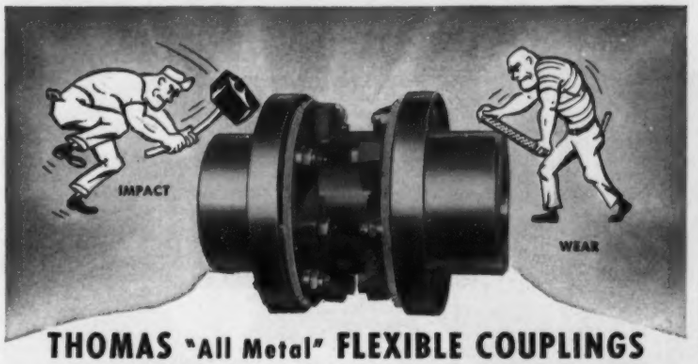
• **LIGHTWEIGHT NUCLEAR GENERATOR** converts heat directly into electrical power. The generator is undergoing performance testing at Air Research and Development Command's Air Force Special Weapons Center in Albuquerque, N. M. It was developed to provide a reliable and long-life power source for facilities such as small unmanned surface radio beacons and weather stations.

The completely portable device weighs less than 40 lb. It produces approximately 150w of electrical power and was designed for one year of continuous unattended operation. It uses radio-active isotopes, such as Curium 242, as its heat source.

The generator's 144 small semiconductive elements are heated by this heat source to a temperature of about 1000F. Finned heat exchangers, which cover the generator like the quills on a porcupine, keep the cold side of the elements at a temperature of 300F. This temperature difference produces a flow of electrical current in the elements. The overall device is 10 inches high and 16 inches in dia.

The nuclear generator was designed and constructed by the new products laboratories of Westinghouse Electric Corp.



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THOMAS FLEXIBLE COUPLING COMPANY
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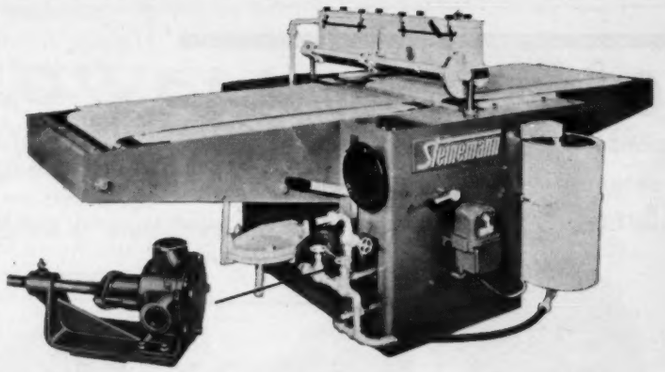

THE MACHINE pictured above is a Pressure Curtain Coater for paint coating and finishing flat, textured, striated, corrugated and many other irregular flat surfaces. Developed, patented and manufactured by the Ulrich Steinemann Company of St. Gallan, Switzerland, the coating machine is also licensed for manufacture in the United States by George Koch Sons, Inc., Evansville, Indiana. Wilco Machine Works, Inc., Memphis, Tenn. are North American Sales Representative. Through exhaustive experiments and tests, Koch's proved that **VIKING PUMPS** were superior to any known or previously used equipment. They are now used internationally on Steinemann equipment, because of their efficient operation. **VIKINGS** help Steinemann machines achieve almost 100% total paint utilization.

This is one of many hundreds of cases where **VIKING PUMPS** play important roles as integral parts of equipment. If you have a situation requiring a smooth, even flow of material, or positive and complete control, check on **VIKING PUMPS.** For information, write for bulletin BJ . . . **VIKING PUMP COMPANY,** Cedar Falls, Iowa, U.S.A. In Canada, it's **"ROTO-KING" PUMPS.** See Our Catalog in Sweet's Product Design File.

50 YEARS

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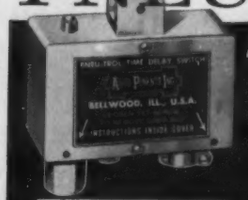
PNEU-TROL



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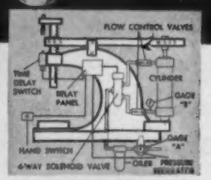
FOR CONTROLLED TIME DWELL OF AIR OR HYDRAULIC CYLINDERS



- Holds dwell accurately to fraction of second
- Automatically re-sets
- Designed for millions of actuations

Arbor press converted to high production power press, using double end cylinder, Time Delay Switch, Flow Control Valves, and related equipment. Flow Valves permit independent ram speed adjustment in both directions. Differential pressure between "A" and "B" gages caused by throttling effect of Flow Control Valve creates time interval in working pressure build-up, which is compensated for by Time Delay Switch setting. This insures consistently accurate working pressure on the ram.

Pneu-Trol Time Delay Switch will hold any cylinder controlled motion or operation at a positive stop on either end of the stroke for ¼ to 60 seconds in 20 to 1 ratios. Simple, easy to adjust. Automatically re-sets after each actuation. Positive, controlled time dwell permits wider use of air or hydraulic power in automatic operations, increases accuracy of work by insuring split-second accuracy of time dwell. Available with many thrust linkages for left and right, down, up, or horizontal thrust. Write for Special Bulletin TDS-59

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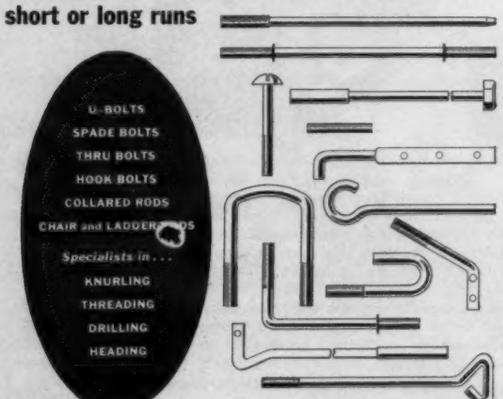

Send drawings or blueprints for quotes and literature.

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RELEASES...

• **ENCAPSULATED DISTRIBUTION TRANSFORMER** utilizes an epoxy resin instead of paper insulation and oil. The unit has a dielectric strength equal to that of conventional oil-type transformers.

Less than one percent of the oil used in oil-type transformers is contained in the encapsulated unit. It will be rated at 80C average winding temperature rise.

Weighing 25 percent less than conventional oil-type transformers, the encapsulated unit is also 25 percent volume smaller and requires 40 to 50 percent less volume.

The transformer was announced by General Electric's Distribution Transformer Dept., Pittsfield, Mass. Presently, there are no plans for making the design commercially available.

• **ELECTRIC MOTOR** for high-temperature service can operate in temperatures ranging from 550F to —65F. The motor is playing a key role in a new electrical throttle-control system developed for the Air Force's B-70 bomber. Its high-temperature range is designed to cope with heating conditions that will be experienced during B-70 flight.

The motor frame is built of stainless steel and wiring is encapsulated in ceramic. The design makes use of an aluminum anodizing method for wire insulation and high-temperature lubricants.

Principal advantage of an electrical throttle-control system is that it will not be subject to the problems of structural deflections and varying temperatures encountered in the airframe during flight. The motor and the throttle-control system were developed by North American Aviation's Los Angeles Div.

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• Equally effective on water, hydraulics, fuels or gas lines. Sweep radius minimizes flow turbulence. Bearings are factory lubricated—sufficient, in normal services for the life of the joint. Fabricated from carbon steel. Temperature rating of 225°F—up to 400°F with Viton A packing. Size range is 1½" to 4". For more information, request Bulletin 11-60.

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EGGS	300
FISH	380
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FRUIT, GRILLED	360
HAM	360
HAMBURGERS	360
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MINUTE STEAK	420
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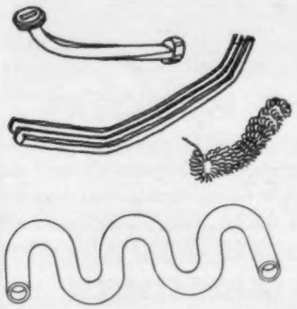
CERROTECHNICS saves TIME • LABOR • MONEY

in bending thin-walled tubing

CERROTECHNICS is the practice of using low-temperature-melting CERRO* ALLOYS to expedite many industrial operations.



For instance: in bending thin-walled tubing and molding, CERRO-BEND is an ideal filler. It is poured into an inclined tube immersed in hot water. The loaded tube is then removed and quenched in cold water, after which it is bent over a forming block or in a bending machine. The alloy melts out in boiling water.

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T.M. Cerro Corporation

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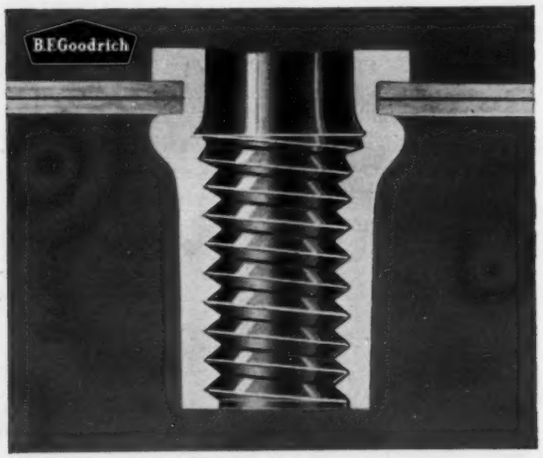

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In any thin-gage material, where tapping would be unsatisfactory, RIVNUTS give you a strong, sturdy nutplate with several internal threads. RIVNUTS are installed "blind", from the exterior of the work. Installation with a heading tool by one person takes just a few seconds. For RIVNUT Data Book write *B. F. Goodrich Aviation Products, a division of The B. F. Goodrich Company, Dept. DN-3, Akron, Ohio.*

B.F.Goodrich Rivnuts

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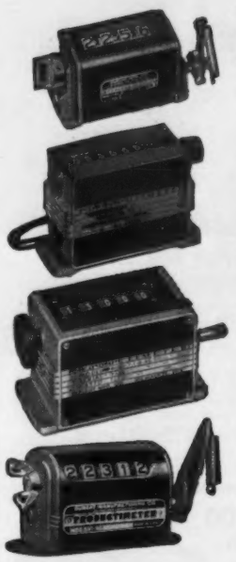
• **TWO AIR-LUBRICATED BEARINGS** hold promise for a wide range of future military and space transportation applications. One bearing, a hydrodynamic or rotating-type cylinder, generates its own air film when rotated at high speeds. The other, a hydrostatic bearing, is made from a special porous sintered powdered metal through which air is forced to form a lubricating film.

The hydrodynamic air bearing is based on the principle of self-induced air pressure resulting from high-speed rotation of a shaft within a cylinder. The bearing contains a mechanical, offset wedge which induces additional air between the metal surfaces during rotation. As a result, the surfaces never touch one another.

Elimination of metal-to-metal contact means almost unlimited life for the bearing and enables it to be exposed to operating temperatures ranging from —300 to 2500F. Temperature variance is limited only to the many different metals from which the bearing can be made.

The hydrostatic air bearing is made from materials similar to those used in oil-impregnated bearings. The oil is simply replaced with airpressurizing through the porous metal to form a lubricating air film.

The bearings were developed by Chrysler Corp.'s Missile Div.



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designed to solve your problems

Speed of operation, simplicity of ratchet control, great strength . . . these are three big reasons why machinery designers write Lowell Reversible Ratchet Wrenches into their specifications.

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- **Engineered for quality performance.**

This Niagara double crank gap frame press for long die area work uses a special built-in Lowell Series 20 Wrench for quick adjustment of the slide.

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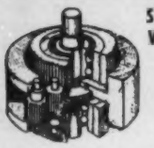
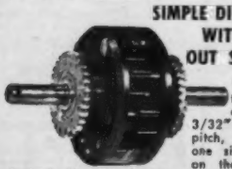
SIMPLE DIFFERENTIAL WITH BALL-BEARING SUN GEARS



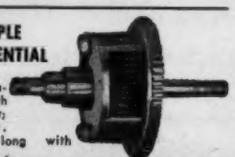
The 1:1 reverse ratio spur gears are 48-tooth, 32 pitch brass with 3/16" available face. On one side, the shaft is 23.64" dia. for 11/16" and has a pin hole, then increases in dia. to .377" for the remaining 3/16" of length. On the other side, the shaft is .377 dia. ¼" lg. 2-13/16" dia. is required to clear the body.
Stock no. A6-115 .....each $15.00

SIMPLE DIFFERENTIAL WITH SPACED OUT SUN GEARS



1:1 reverse ratio spur gears are aluminum, 3/32" face, 32 pitch, 32 tooth on one side, 48 tooth on the other. The body is ¾ thick, but the sun gears are spaced out so that they are 1½" apart. ¼" dia. shaft on each side is 23/32" long. OA length 3½". Requires 1-23/32" dia. to clear the body.
Stock no. A6-124..... each $4.50

SIMPLE DIFFERENTIAL

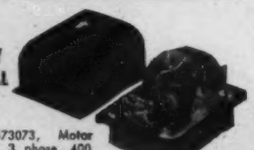


1:1 reverse ratio, 60 teeth on large gear; ¼" shaft.
Size: 3" long with 1-15/16" dia.
Stock no. A6-104 .....each $3.95

DUAL SIMPLE DIFFERENTIAL

1:1 reverse ratio on both.
Size: 3¼" long x 1-7/16" dia. Shaft size: ⅛" and 5/32".
Stock no. A6-107 .....each $7.50

SPERRY VERTICAL GYRO



Part #673073, Motor 115 volts, 3 phase, 400 cycle, 8 watts, 20,000 RPM. 3-minute runup, synchro pickoffs, roll 360°, pitch 85°. Synchro excitation 26 volts, 400 cycle, 150 m.a. Vertical accuracy ±½°. Weight 3½ lbs. Approx. dim. 5¾" L., 4½" W., 4½" H.
Price $35.00

MINNEAPOLIS-HONEYWELL RATE GYRO (Control Flight)

Part no. JG7005A, 115 volts A.C., 400 cycle, single phase potentiometer take off resistance 530 ohms. Speed 21,000 r.p.m. Angular momentum 2½ million, CM²/sec. Weight 2 lbs. Dimensions 4-7/32 x 3-29/32 x 3-31/64.
Price $22.50

VARIABLE SPEED BALL DISC INTEGRATORS

(All Shafts Ball Bearing Supported)

No. 145 Forward & Reverse 2¼"-0-2¼". Input shaft spline gear 12 teeth 9/32" dia. ⅜" long. Output shaft 15/64" dia. x 15/32" long. Control shaft 11/32" x ⅜" long. Cast aluminum construction. Approx. size 3" x 3" x 2¼" $17.50

No. 146 Forward & Reverse 4-0-4. Input shaft 5/16" dia. x ½" long; Output shaft 15/64" dia. x 9/16" long. Control shaft 11/64" dia. x 11/16" long. Cast aluminum construction. Approx. size 4½" x 4½" x 4". **$18.50 ea.**

SMALL DC MOTORS

(approx. size over 3¼" x 1¼" dia.:

5067043 Delco 12 VDC PM 1" x 1" x 2", 10,000 rpm.	$7.50
5067126 Delco PM, 27 VDC, 125 RPM, Governor Controlled	15.00 ea.
5069600 Delco PM 27.5 VDC 250 rpm	12.50
#5069625 120 rpm, mfr. Delco, 27 VDC governor controlled	$15.00
5069230 Delco PM 27.5 VDC 145 rpm	15.00
5068750 Delco 27.5 VDC 160 rpm w. brake	6.50
5068571 Delco PM 27.5 VDC 10,000 rpm (1x1x2")	5.00
5069790 Delco PM, 27 VDC, 100 RPM, Governor Controlled	15.00 ea
#5069800 575 rpm, mfr. Delco, 27 VDC, PM reversible governor controlled, equipped with 27 VDC clutch	$17.50
5072735 Delco 27 VDC 200 rpm governor controlled.	15.00
5BA10A118 GE 24 VDC 110 rpm	10.00
5BA10AJ37 GE 27 VDC 250 rpm reversible	10.00
5BA10AJ52 27 VDC 145 rpm reversible	12.50
5BA10AJ50, G.E., 12 VDC, 140 rpm	15.00
5BA10FJ401B, G.E. 28 VDC, 215 rpm, 10 oz. in., 7 amp. contains brake	15.00
5BA10FJ421, G.E. 26 VDC, 4 rpm, reversible, 6 oz. in., .65 amp	15.00

400 CYCLE PM GENERATOR

Mfgd. by T K M Electric Corp.
Model #A-12
120/208 volts, 400 cycle, 1 or 3 phase, 1 kva, pf 0.8, rpm 8,000. Approx. dim. 6" x 5½". Internal spline drive. Price $100.00

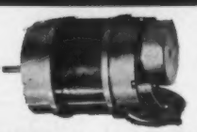
400 CYCLE ⅓ PHASE GENERATOR

115 VAC. 3 KVA. Mfg. Bogue Elect. Mod. 2800S. External excitation 107 VDC. 1.1 amp. 3450 rpm. 1" shaft. $200.00

400 CYCLE MOTOR GENERATOR

2kw, 208/115 volt AC, 3 phase, 400 cycle
Input: 220 volts AC, 60 cycle, 3 phase 3 h.p. motor
Unit manufactured by Bogue
Consists of squirrel cage induction motor driving through a flexible tubing, a salient pole, synchronous generator, with direct connected exciter.
Unit complete with starting contractor, voltage adjusting rheostat, carbon pile voltage regulator and 28 volt DC, 5 amp rectifier power supply.
Price $450.00

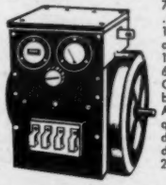
SELSYNS-SYNCHROS



1CT cont. Trans 90/55V 60 cy.	$27.50
1DG Diff. Gen. 90/90V 60 cy.	34.50
1F Syn. Mtr. 115/90V 60 cy.	34.50
1G Gen. 115V 60 cy.	34.50
1HDG	37.50
1HCT	37.50
1SF Syn. Mtr. 115/90V 400 cy.	12.50
23TR4 torque receiver	34.50
23TR6 torque receiver	37.50
23CT6 control transformer	37.50
23CX6 control transmitter	37.50
7DG differential generator	37.50
2J1F1 Gen. 115/57.5V 400 cy.	7.50
2J1F3 Gen. 115/57.5V 400 cy.	10.00
2J1FA1 Gen. 115/57.5V 400 cy.	7.50
2J1G1 57.5/57.5V 400 cy.	5.00
2J1H1 Diff. Gen. 57.5V 400 cy.	7.50
2J5D1 Cont. Trans. 105/55V 60 cy.	17.50
2J5F1 Cont. Trans. 105/55V 60 cy.	17.50
2J5H1 Gen. 115/105V 60 cy.	17.50
2J15M1 Gen. 115/57.5V 400 cy.	17.50
5CT Cont. Trans. 90/55V 60 cy.	34.50
5D Diff. Mtr. 90/90V 60 cy.	34.50
5DG Diff. Gen. 90/90V 60 cy.	34.50
5F Syn. Mtr. 115/90 VAC 60 cy.	34.50
5G Syn. Gen. 115/90VAC 60 cy.	34.50
5HCT Cont. Trans. 90/55V 60 cy.	37.50
5SDG Diff. Gen. 90/90V 400 cy.	12.50
6DG Diff. Gen. 90/90V 60 cy.	25.00
6G Syn. Gen. 115/90VAC 60 cy.	34.50
7G Syn. Gen. 115/90VAC 60 cy.	42.50
C56701 Type 11-4 Rep. 115V 60 cy.	20.00
C69405-2 Type 1-1 Transm. 115V 60 cy.	20.00
C69406 Syn. Transm. 115V 60 cy.	20.00
C69406-1 Type 11-2 Rep. 115V 60 cy.	20.00
C78248 Syn. Transm. 115V 60 cy.	12.50
C78410 Repeater 115V 60 cy.	20.00
FPE 49-7 Diehl servo motor, 115 volts, 60 cycle, 10 watts	30.00

400 CYCLE, 3 PHASE GENERATOR

BY MASTER ELECTRIC



Type AG, frame 364Y 7.5 kw, 3428 rpm, pf .95 Star connected 120/208 3 phase, 22 amps. Delta connected 120 volt single phase 6 amps. Self excited. Complete with control box, voltage regulator, AC voltmeter and frequency meter. Shaft 1" dia., 2" long; overall dim. of unit: 21"6x18"x 20".
Price $395.00 each

SILICON RECTIFIERS

All rectifiers listed at maximum peak inverse voltage ratings; approximate forward voltage drop, 1.5 volts

N1446	.750 amp.	100 volts	.65
1N1447	.750 amp.	200 volts	.75
1N1448	.750 amp.	300 volts	.85
1N1449	.750 amp.	400 volts	1.00
1N1551	1 amp.	100 volts	.80
1N1552	1 amp.	200 volts	.95
1N1553	1 amp.	300 volts	1.10
1N1450	5 amp.	100 volts	1.00
1N1451	5 amp.	200 volts	1.25
1N1452	5 amp.	300 volts	1.50
1N1453	5 amp.	400 volts	2.00
1N1454	25 amp.	100 volts	3.00
1N1455	25 amp.	200 volts	3.50
1N1456	25 amp.	300 volts	4.50
1N1458	35 amp.	100 volts	3.50
1N1459	35 amp.	200 volts	4.00
1N1460	35 amp.	300 volts	4.50
1N1461	35 amp.	400 volts	5.00
1N05P7	50 amp.	50 volts	6.00
1N1462	50 amp.	100 volts	7.00
1N05R7	75 amp.	50 volts	9.00
1N1466	75 amp.	100 volts	10.00
1N1467	75 amp.	200 volts	11.00
1N1468	75 amp.	300 volts	12.50
10T7	100 amp.	100 volts	13.00
00T7	100 amp.	150 volts	13.50
1N05V7	150 amp.	50 volts	16.50
1N1474	150 amp.	100 volts	17.00

Mounting for full wave bridge circuit to accommodate .750 amp. rectifiers...75¢ each

Circle 186 on Reader-Service Card for more information

RELEASES...

• **HIGH-VACUUM FURNACE** capable of reaching temperatures of 2600C at a vacuum of 10^{-6} mm Hg is one of the largest such devices ever constructed. Its present heating area is 6 inches in dia and 7 inches high. Size can be expanded to at least 12 inches in dia and height.

The furnace has a 30-inch dia outer dome of stainless steel, 30 inches high with four 6-inch ports on the side and a 12-inch port on top. This bell can be lifted completely clear of the device, thereby providing easy access to the furnace heating assembly.

Heating is accomplished by passing a 3000-amp current through a circular tungsten element surrounded by multiple layers of thin tantalum foil which act as heat shields. Heat shielding results in maximum temperature uniformity throughout the heated area.

Vacuum apparatus for the chamber consists of a 46-cfm roughing pump and a 6-inch oil diffusion pump. The furnace can be reduced to 10^{-6} mm Hg pressure in approximately four minutes' pumping time.

The furnace has been developed by Electro-Optical Systems, Inc.

• **GLASS FIBER ROTOR BLADE** for helicopters promises improved blade fatigue resistance and major savings in production and maintenance costs. Blades presently flown by Kaman Aircraft Corp. on an H-4 helicopter are transluscent except for the leading edge which is constructed of heavier glass fiber material. Color pigmented blades will eliminate the need for supplemental finishes.

STEPLESS VARIABLE SPEED

SETS AND RESETS ACCURATELY

PRECISION CONTROL

This Zero-Max screw control gives exact speed settings. It is one of many options from the standard lever type control.

Zero-Max drives deliver constant torque, are truly stepless—zero to maximum—available with instant reverse and neutral. They are low cost, small in size but big in power and performance. Over 30 basic fhp models (1/15 to 3/4 hp) carry torque ratings of 3 to 450 in. lbs. and speed ranges to 0 to 1200 rpm. Drives come with or without motors and gearheads.

Send for free catalog and name of your nearest representative.

The **ZERO-MAX** *Company*

2857 Harriet Avenue South
Minneapolis 8, Minn.
TAylor 7-5521

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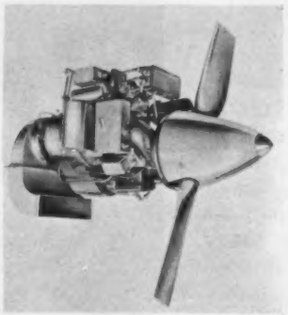


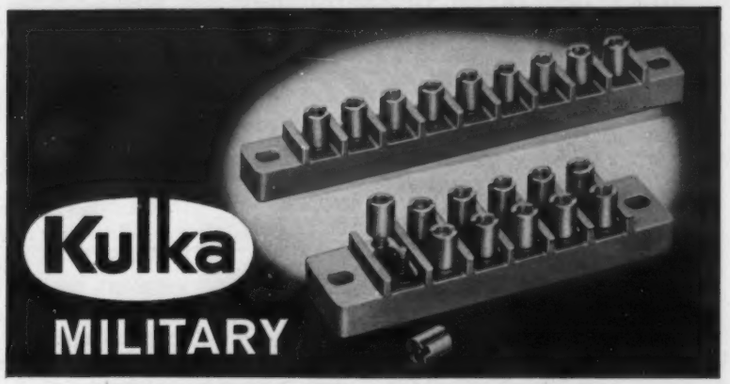
• **60- AND 90-HP GAS TURBINES** are believed to be the world's smallest turboprop aircraft engines. Both have single-stage, axial-flow-type turbines.

External dimensions measure 27.5 inches in height and 30.1 inches in length (without propeller and spinner). Weight is 235 lb.

The 60-hp version is designed to be fitted with a mechanically operated variable-pitch propeller. Because of the greater power output of the 90-hp version, a hydraulically operated variable-pitch propeller is required.

The gas turbine engines can be installed as conversion power units for light aircraft without any major airframe modifications. Fuel can be either kerosene or diesel fuel, offering increased safety together with economic operation.

The TP60 and TP90 are by-products of development work on gas turbine engines for automobiles done by The Rover Co., Ltd., Solihull, England.



TERMINAL BOARDS

Kulka Military Terminal Boards were designed by the Bureau of Ships according to MIL-T-16784B. They are made to BUSHIPS 9000-S6505-73214 drawings, with latest revisions, and BUORD S64101.

Kulka Military Boards are available as single row, double row, or through connected type units, and are molded of Type MAI-60 glass-filled alkyd resin according to the latest revision of M-14 specifications.

Kulka offers the complete line of these Military Boards, along with a wide selection of hardware accessories...

See Kulka at I.R.E. Booth 2900

The complete catalog on Military Terminal Boards.... Write for your FREE copy...

KULKA ELECTRIC CORP.

633-643 SO. FULTON AVENUE, MOUNT VERNON, N. Y.

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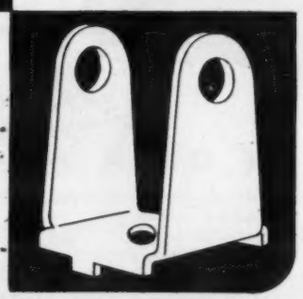
Casting... $1.18
Stamping.... 53
SAVED 65c
PER PART*



Originally this grey iron casting required expensive milling and drilling operations. In 350 lots the piece price was $1.18 plus pattern, milling fixture and drill jig charges.

*Converting to a stamping formed from 12 gage sheet steel cut the piece price to 53¢ including tooling. The present stamping is lighter, stronger, better duplicated and improved overall. Bulletin F-185 explains this highly efficient, specialized technique for cutting the work load and costs of metal fabricators. Write for it today.

DAYTON ROGERS *Manufacturing Company*

MINNEAPOLIS 7U, MINNESOTA

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SYNCHRO NEWS!

VERNITRON 3-MINUTE CONTROL SYNCHROS DELIVERED ON REGULAR PRODUCTION BASIS

ALL SIZES—11 through 23
ALL TYPES — Transformers, Transmitters, Differential Transmitters — Thru-Bore and Standard
ALL ENGINEERED & MANUFACTURED TO:
MIL-S-2335 MIL-S-16892 FXS-1066
MIL-S-12472 MIL-S-20708A
ALL AVAILABLE WITH MAXIMUM ELECTRICAL ERROR OF ±3 MINUTES! A major break-through, made possible by VERNITRON specialization in precision synchro component design and manufacture.

60 & 400 CYCLE

WRITE, WIRE, PHONE NOW for complete price, delivery and specification data; ask for new **Vernitron Catalog**

VERNITRON CORPORATION

THE QUALITY NAME IN PRECISION SERVO COMPONENTS

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West Coast Plant: 1742 So. Crenshaw Blvd., Torrance, Cal.—FAirfax 8-2504 TWX: TNC-4301

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*PUREBON

SELF LUBRICATING
LOW FRICTION
STABLE AT HIGH TEMPERATURES

*carbon-graphite especially designed for mechanical applications

REQUEST BULLETIN NO. 60 OR SEE SWEET'S PRODUCT DESIGN FILE

Sliding or rotating components compounded and molded of Purebon are self-lubricating; the material is unusually stable at high temperatures. It is readily machinable, chemically inert, light weight, low cost when moldable to size. Send prints or parts for prompt quotation.

PURE CARBON CO., INC.
447 HALL AVE., ST. MARYS, PA.

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RELEASES...

• **"WHITE LIGHT" ILLUMINATION** for cockpit instruments is being put to its first operational use in the USAF-Northrop T-38A Talon supersonic trainer. Use of this filtered white light system in aircraft cockpits will enable pilots flying at night to distinguish color on instruments and maps. The system uses a blue filter to make what appears to be "white" light truly white.

In present red-illuminated cockpits with light diffused on instruments through a red filter, only red and black markings can be seen. White light will insure pilots a more accurate visual perception.

Red light has been used because it supposedly required less time for a pilot's eyes to adapt to night vision. However, human factors engineers have since learned there is no appreciable difference in adaptation time between low-intensity red light and low-intensity white light. The latter provides the advantage of color detection.

Cooperation between the Air Force and engineers of Northrop Corp.'s Norair Div. produced the T-38 white-lighted cockpit design.

AERO-SEAL JET® WORM DRIVE HOSE CLAMP

Designers know that sometimes even a relatively simple device is almost impossible to imitate, and AERO-SEAL has proved this point in the hose clamp field. The patented AERO-SEAL JET, for example, provides all of the advantages—including the security—of a precision worm drive clamp, yet permits almost instantaneous installation or removal. And AERO-SEAL bands and housings are of 302-18-8 stainless steel. All stainless also available.

AERO-SEAL solves countless fastening problems in electrical appliances, electronic, and chemical equipment. Complete range of sizes from 7/16" to 15 feet. Ask your industrial jobber.

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700 Liberty Avenue, Union, N.J. · Cable Address: Breeze, Union, N.J.

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FROM Metron

A PART OR A PACKAGE

A PART: *Miniature adjustable ratio speed changers*
RATIOS: 1:5 up to 5:1 down
(continuously variable over 25:1 range)
HORSEPOWER: .025 max. either shaft
TORQUE: 5 to 40 oz-in depending upon ratio
SPEED: 10,000 RPM max.
WEIGHT: 8 oz.
BEARINGS: double, heavy-duty ball
DELIVERY: 10 days

A PACKAGE: Call Metron now if you need help with speed changing design problems. Our 18 years of experience with miniature speed changers and precision instruments is at your service to design and build mechanical or electro-mechanical packages. Send your prints today and you'll hear from us promptly!

Metron
METRON INSTRUMENT CO.
432 Lincoln, Denver 3, Colo., PE 3-3764, TWX: Dn 194

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FEL-PRO C5-A

for HIGH PRESSURE AND TEMPERATURE up to +1500° F.

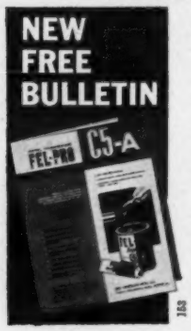
Colloidal Copper Compound

has dozens of uses as a

Sealant-Protectant-Lubricant

This PROVEN "Hi-Temp" Compound, originally designed for use as an anti-seize compound for difficult high temperature application is now being successfully used on such products as: ***• valve bodies • tape recorders • manifolds • milling machines • aircraft and missiles • jet engines • pumps • drills • heat exchangers, etc.***

NEW FREE BULLETIN



Wherever an application calls for superior lubrication, high pressure sealing or protection from rust and corrosion, Fel-Pro C5-A colloidal copper compound may be a new low cost answer.

C5-A prevents seizing and galling. Protects stainless steel in high pressure, high temperature applications. It can be used on all metals, alloys and most plastics. You'll find many cost cutting, performance increasing ideas in the Free Bulletin. Send for a copy of the C5-A Bulletin now.

FELT PRODUCTS MFG. CO.
7450 North McCormick Blvd., Skokie, Illinois
Dept. 86, (Chicago suburb)

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SQUARE D's

ALL-METAL Push Buttons

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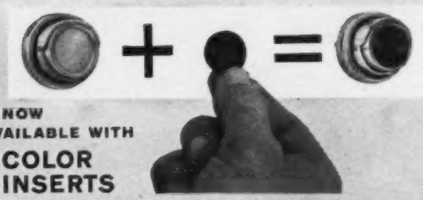
EXTRA DURABILITY!



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COLOR INSERTS

—with these Important Advantages:

- Indestructible all-metal operator
- Permanently colored high-density polyethylene inserts
- Easy-to-use inserts can be changed in seconds
- 7 colors available—black, red, green, brown, yellow, orange, blue
- New "universal" package contains basic operator, and 7 inserts at no extra cost

Write for Bulletin 9001-T. Square D Company, Dept. SA, 4041 North Richards Street, Milwaukee 12, Wis.

SQUARE D COMPANY

wherever electricity is distributed and controlled

Circle 220 on Reader-Service Card for more information

• THERMOELECTRIC COOLING DEVICE, developed by Hughes Aircraft Co., is so efficient it can freeze or boil a drop of water on power from two flashlight batteries. The device, smaller than a paper clip, heats or cools at the flip of a switch. In clusters, its uses vary from maintaining room temperature in a space ship to operating an instant-defrosting refrigerator with no moving parts.

The device, also known as a Peltier cooler, produces heat at the junction of two special semiconductor materials when a current is passed through it. It cools when the direction of current flow is reversed. A new technique of fabricating the thermoelectric material reduces current consumption to 1/10 of that previously needed.

Hughes has built a three-stage "cascaded" cooler that brings temperature down to —100F. It is being used to cool an experimental infrared detector. The device requires only two amps of current.

POWER from two flashlight batteries can freeze water by means of thermoelectric device. When switch reverses current flow, device becomes heater and in few seconds ice disappears in wisp of steam.

NEWS FROM THE ORIGINATORS OF METAL-SEAL FITTINGS

the 'CN' metal-seal tube fitting SEALS ALL straight-thread ports

Seal Ports in ALL Base Metals—Steel, Cast Iron, and Aluminum: L & L's 'CN' fittings are now made with a new special metal seal ring that works perfectly no matter what the component base metal.

Seal ALL Straight-Thread Port Designs—There's no change in the ability of 'CN' fittings to seal perfectly the S.A.E. port design, as well as the UN port design (the ultimate port for both O-ring and metal seal fittings).

Captive nut wedges the metal seal ring into port angle. Resulting seal is unaffected by vibration, exotic fluids, high temperatures. Seal can be remade repeatedly.

Write for "Leak-Proof Port Connections"

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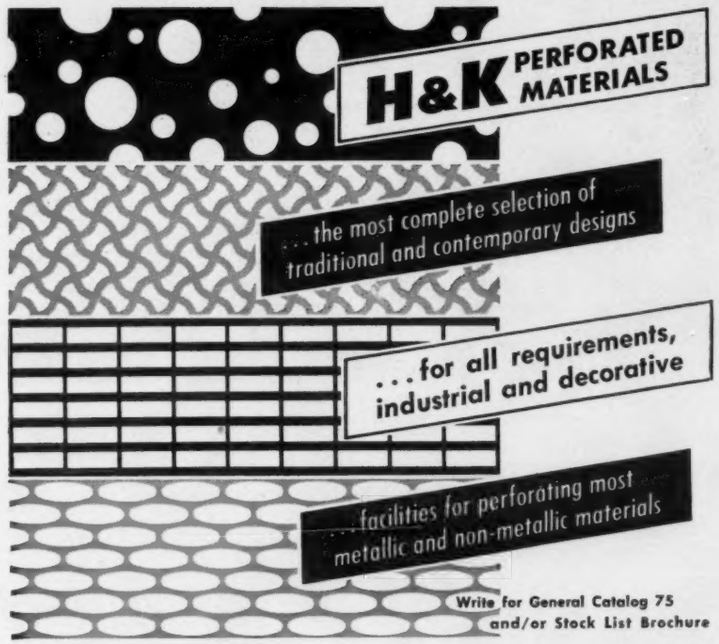
H&K PERFORATED MATERIALS
...the most complete selection of traditional and contemporary designs
...for all requirements, industrial and decorative
...facilities for perforating most metallic and non-metallic materials

Write for General Catalog 75 and/or Stock List Brochure

FIND NEAREST H&K AGENT in the 'Yellow Pages' Listed Under "Perforated Metals"

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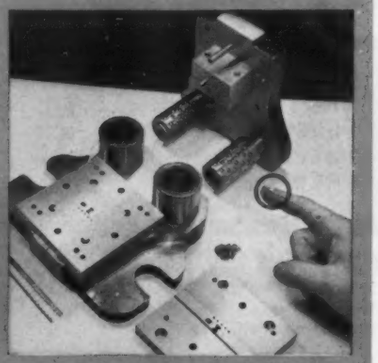
NOBODY SAID "It Couldn't Be Done"

BUT ONLY LEMPCO 2 POST STOCK* DIE SETS COULD DO IT!

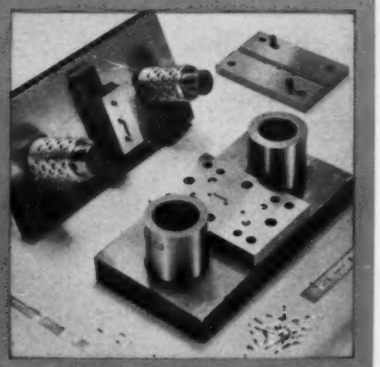
To the best of our knowledge, Lempco is the only 2-post STOCK* die set which could produce this electronics part from .001" thick high nickel alloy material—with punched holes of .001" diameter. This die, mounted in a standard Lempco STOCK* die set, produced 30,000 burr-free parts on its initial run.

Users everywhere have found that a STOCK* Lempco 2-post die set will out-produce special 4-post "friction type" sets—at a fraction of the cost. You can prove this to yourself!

"Off-the-shelf DELIVERY, with warehouse stocks in all major metalworking areas of the U.S.A.



MATERIAL: .001" Thick, High Nickel Alloy
Punched Holes, .001" Diameter



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PLANS AND CROSS-SECTIONS

. . . To Talk of Many Things, Of Glop—and Gunk—and Boomerangs, Of Disneyland and Rings . . .

If you'd expect to find a baby in a "baby bath" or a duck in a "duck pond", you haven't taken a stroll down an automotive assembly line lately. Chrysler Corp. notes that its assembly line has its own special language, described as "picturesque".

Before we introduce you to a few of these picturesque words, note what the company says about its vernacular tongue, "Employees use the language effectively and accurately on the job. Although some of the words may sound non-sensible, they convey a definite, particular meaning. The most important thing, however, is the improved communication which results in the usage of the language."

Baby Bath—The well lining into which the convertible top folds.
Bathtub—A cup-shaped recession into which an ornament is attached.
Blacksmith—A metal finisher.
Boomerang—Any molding having a wide-open "U" shape.
Bull Ring—Area of the assembly line where body shell is welded together.
Disneyland—Engineering section of assembly plant.
Duck Pond—Area where bodies are wet-sanded in preparation for painting.
Eye Brow—Chrome header molding over headlights or back lights.
Glop—Glue to hold discs to sanding wheels for metal-finish.
Gunk—A sealing material used on body seams.
Hog Rings—Wire clips used to secure trim to seat springs.
Idiot Stick—Automation stick, or a pry bar used to push dollies jammed on conveyor or off conveyor.
Mule—Tow tractor.
Rag Hangers—Headlining assembler.
Squirt & Rub—Paint department.
Tin Benders—Sheet metal engineers.
Zipping—Assembly operation in windshield installation.

Facts . . .

You May Have Missed

. . . A baseball pitched at a moderate speed with a spin of 30 rps can be expected to curve about 18 inches enroute to home plate.

. . . The earth's equator is egg-shaped, not circular.

. . . A computer has designed a chemical plant that would cost from $250,000 to $600,000 less to build than the best previous design.

. . . Twelve thousand volunteer weather observers throughout the country record weather information for the U. S. Weather Bureau.

I'll look at that drawing now—the day is shot anyway.

EXTREME RELIABILITY
Virtually Unlimited POWER

are yours with the...

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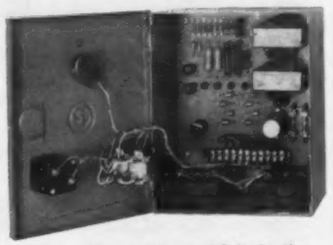
POWER MAX
SERVOMECHANISM



Now ordinary AC induction motors thru integral HP sizes . . . including existing installations . . . can be driven by solid state **POWER MAX** Servo amplifiers.
All electric automatic feedback control systems become feasible for large throttling valves and the largest mechanical adjustable speed drives.
Instant warm up, no relays or moving parts except the motor rotor and conservatively loaded components provide the convenience and reliability demanded by industry.
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Circle 224 on Reader-Service Card for more information

YOU NEED RUBBER HARDNESS CONTROL

Essential for INSPECTORS ENGINEERS USERS OF RUBBER PARTS

"Vest Pocket" Model 1500
With Easy-to-Read Vernier

Rex

Rubber Hardness Gauges

The *EXACT* Hardness of Rubber and other Elastomers can easily be measured and verified in Durometer "A" Units. ASTM and MIL spec. approved. Lifetime accuracy.

Write for prices and data sheet on Rubber Hardness Testing.

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P.O. BOX 46, GLENVIEW, ILL.
PHONE: PArk 4-6668

Circle 225 on Reader-Service Card for more information

• **COCKPIT PORTION** of the FAA's Automatic Ground-Air Communication System will be designed and built by Lear, Inc. Both incoming and outgoing messages are displayed on the Lear Airborne Insertion-Display equipment.

Messages composed of letters and numbers reading from left to right in natural syntax will be presented on a single 4½- by 5½-inch panel.

The instrument will be capable of displaying 64 separate words and phrases, which, coupled with four additional number-and-word readouts, offers an almost infinite number of message variables.

Color coding will differentiate incoming and outgoing messages and a selective memory function will provide pilot and controller with the last message received on their respective displays.

PUSH-BUTTON AIR TRAFFIC COMMUNICATIONS DISPLAY is intended to reduce voice communication, which is saturating existing channels as air traffic increases.

HOBBS HOUR METERS
GIVE THE REAL FACTS OF INDUSTRIAL TOOL USE AND MAINTENANCE

Hobbs Industrial Hour Meters provide continuous supervision of the running time of industrial machines . . . eliminating errors and deficiencies for maximum production. These elapsed time indicators tell when servicing is due . . . indicate the costs of running hour for both the machine and occupied space.

Hobbs Industrial Hour Meters make it easy to determine the life and repair costs per running hour of industrial machines . . . the actual running time of leased equipment and equipment to be sold. They set up a sound basis for service contracts. For complete information . . .

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A DIVISION OF STEWART-WARNER CORPORATION
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MARVEL SYNCLINAL FILTERS
For Dependable Protection on Hydraulic Equipment

SUMP TYPE
(Cutaway)

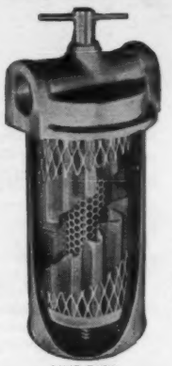
PRODUCTION ENGINEERS and MAINTENANCE MEN, whose job it is to keep machinery operating at peak efficiency, are specifying Marvel Synclinal Filters on new equipment and standardizing with Marvels on all existing equipment.

Hydraulic Oils MUST BE CLEAN
to Protect Equipment and Reduce Maintenance.

IT'S THE *ACTIVE* FILTERING AREA THAT COUNTS!

The Synclinal design of Marvel Filters provides that all-important balance between maximum ACTIVE filtering area and sufficient storage capacity for filtered out particles. Thus, longer periods of operation are attained before filter cleaning becomes necessary. Marvel Synclinal Filters are easy to clean because both sump and line types may be disassembled, thoroughly cleaned and reassembled, on the spot, in a matter of minutes. Line type may be serviced without disturbing pipe connections. They meet J. I. C. Standards.

OVER 900 ORIGINAL EQUIPMENT MANUFACTURERS NOW INSTALL MARVEL SYNCLINAL FILTERS AS STANDARD EQUIPMENT.



LINE TYPE
(Cutaway)

IN-LINE FILTER
Handles up to 25 G.P.M. of hydraulic oil at very low pressure drop. Monel wire cloth filtering media in mesh sizes from 30 to 200. Cartridge is easily removed for cleaning.

A SIZE FOR EVERY NEED
Available for sump or line installation in capacities from 5 to 100 G.P.M. Choice of Monel mesh sizes range from coarse 30 to fine 200.

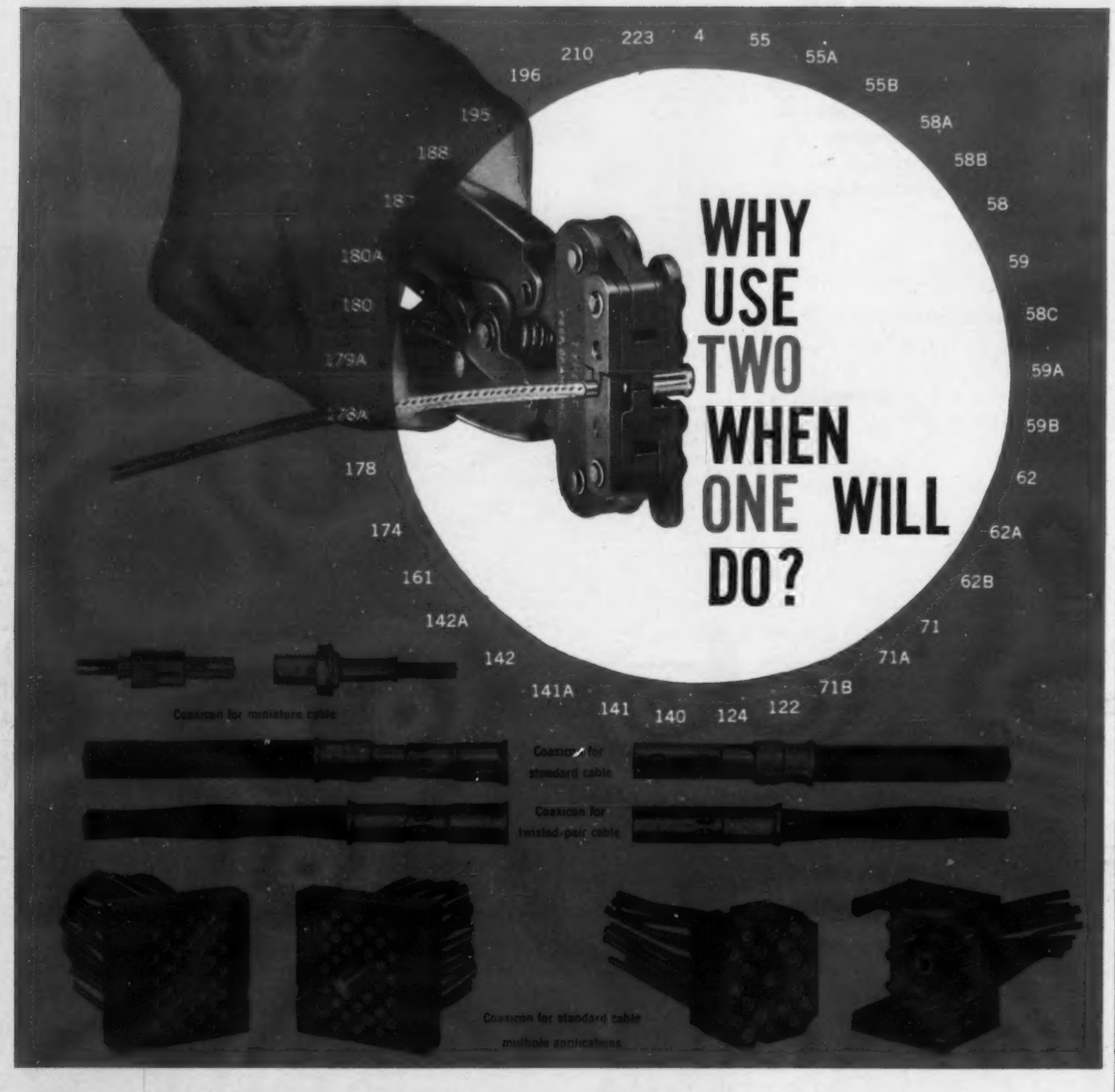
IMMEDIATE DELIVERY

wire, phone or use coupon below.
For further information, write,

MARVEL ENGINEERING COMPANY
7227 N. Hamlin Ave., Chicago 45, Ill. PHONE: Juniper 8-6023

Without obligation, please send me complete data on Marvel Synclinal Filters, as indicated—
☐ Catalog #108—For Hydraulic Oils, Coolants, Lubricants
☐ Catalog #200 For Fire-resistant Hydraulic Fluids (Aqueous Base)
☐ Catalog #400—For Fire-resistant Hydraulic Fluids (Synthetic)
☐ Catalog #301—For Water

Name DN-3
Company .....
Address .....
City .....
State .....


WHY USE TWO WHEN ONE WILL DO?
223 4 55 55A 55B 58A 58B 58 59 58C 59A 59B 62 62A 62B 71 71A 71B 122 124 140 141 141A 142 142A 161 174 178 178A 179A 180 180A 188 196 210
Coaxicon for miniature cable
Coaxicon for standard cable
Coaxicon for twisted-pair cable
Coaxicon for standard cable multiple applications

When you've got to attach a connector contact to the end of a coaxial wire, a single precise stroke of a crimping tool (one that crimps braid and inner conductor to the contact simultaneously) is the fastest way, the lowest-installed-cost way, the way that cuts human error in half . . . THE AMP WAY.

Our COAXICON® contact is designed on this principle: two strokes here is one too many!

COAXICON is a one-piece contact. It can be attached, simultaneously, with a single crimping tool stroke, to the braid and inner conductor of 37 sizes of RG/U coaxial cable up to ¼" O.D. (see size numbers above). And AMP makes the tools — hand and automatic — that control the crimp.

COAXICON consists of polarized, concentric male and female shells, made from drawn parts. The inner contacts, assembled in the shells, will attach equally to solid or stranded conductors. Where contact density is important, a miniature COAXICON fulfills the requirement.

COAXICON connectors will match cable impedances in the 50-100 ohm range, at frequencies as high as 150 megacycles. Impedance mis-match, incidentally, is only 1.06 to 1.09, even at 500 megacycles.

Write today for complete product information.

AMP INCORPORATED

GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

AMP products and engineering assistance are available through subsidiary companies in: Australia • Canada • England • France • Holland • Italy • Japan • Mexico • West Germany

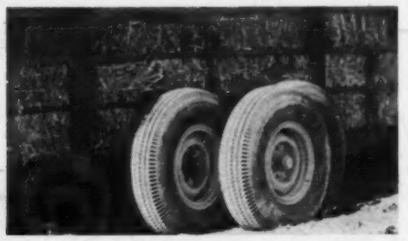
Circle 227 on Reader-Service Card for more information

RELEASES...

• **SIX-WHEEL ARRANGEMENT** lets a hay loader and stacking wagon travel smoothly over ditches, hillsides and corrugated fields. Six tires give the wagon good flotation on soft ground and support an 8-ton load of 207 bales for long hauls on the highway.

Three wheels on each side are grouped together as a staggered tandem. Two of the wheels are flush with the wagon frame and run in the same track. The third wheel, located in the middle and a tire width outside the other two, is on a "floating" axle that allows the tire to follow the contour of the ground. The third wheel acts as a pivot point and eliminates torque and twist that is common when tandem wheel suspensions are used to make sharp turns.

The wagon was developed by Ezra C. Lundahl Mfg. Co., Logan, Utah.



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Columbus, Ohio Mar. 27-31	Symposium on Temperature, Its Measurement and Control in Science and Industry, Instrument Society of America, Veteran's Memorial Hall and Deshler-Hilton Hotel.
Dallas, Tex. Mar. 28-29	MEETING of the American Nuclear Society on "Nucleonics in Flight", Hilton Hotel.
San Jose, Calif. April	CONFERENCE on Electro-Optical and Radiation Devices, Sponsored by the Institute of Radio Engineers and American Institute of Electrical Engineers.
Cincinnati, Ohio April	CONFERENCE on Joint Automatic Techniques, Sponsored by the Institute of Radio Engineers, American Institute of Electrical Engineers, and American Society of Mechanical Engineers.

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Published bi-weekly by Rogers Publishing Co. **Norman L. Cahners,** Chairman of the Board; **E. S. Safford,** President; **Saul Goldweitz, G. F. Taylor,** Vice Presidents. Editorial, Advertising and Subscription Offices: 3375 S. Bannock, Englewood, Colo. Telephone: SUnset 9-0571. Printed at 85 W. Harrison St., Chicago 5, Ill. Accepted as Controlled Circulation Publication at Chicago, Illinois. Send form 3579 to subscription offices.

Circulated to design engineers in the U.S. original equipment manufacturing industry—plants with more than 20 employees and which manufacture machinery or equipment of their own design. Design engineers responsible for specification of components, materials or engineering department may receive DESIGN NEWS without charge. Written request on company letterhead required. Subscriptions to others in continental United States, $1 per copy, $20 per year. Please send requests for subscriptions and change of address to Circulation Manager, DESIGN NEWS, Englewood, Colorado.

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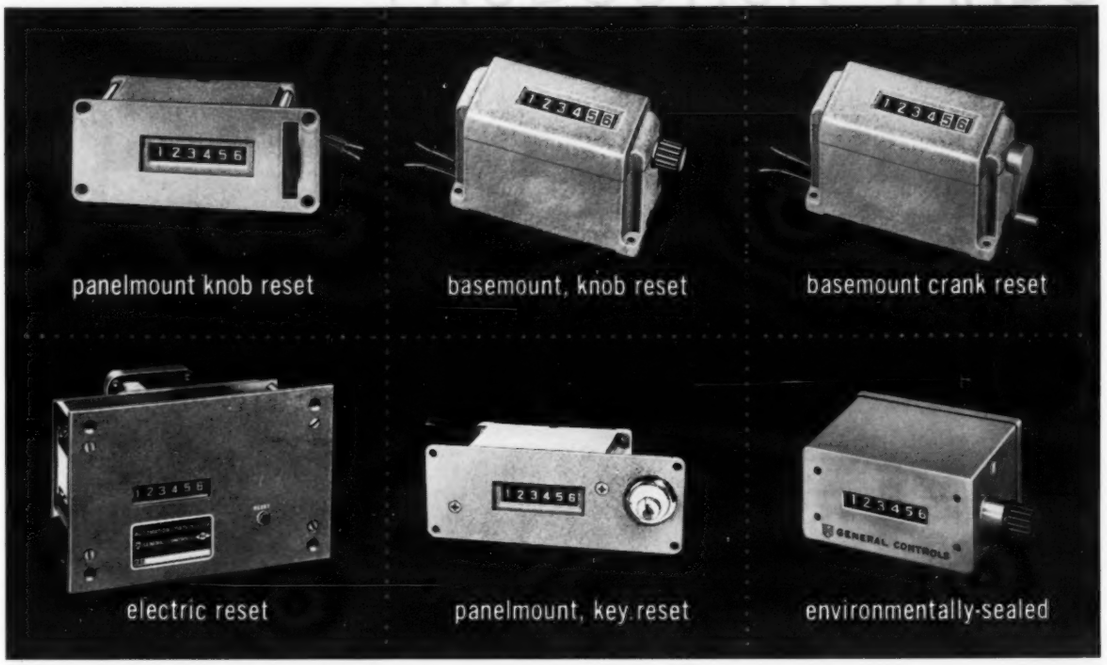

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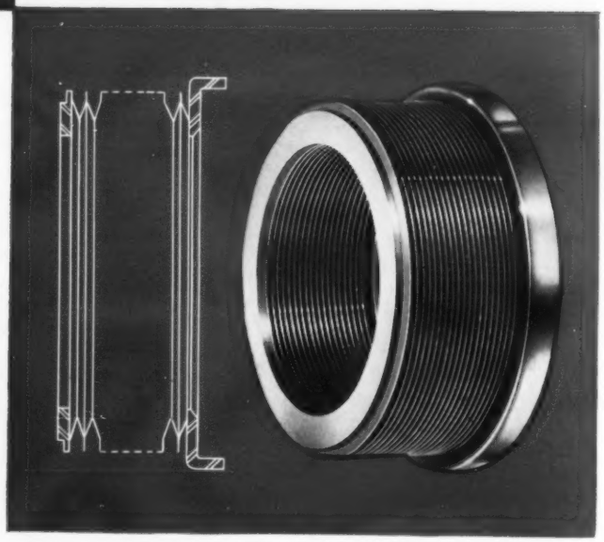
C/R DESIGN NOTES

How C/R's New Metal Bellows Seal Meets Seemingly Impossible Operating Conditions



Operating Ranges

Temperature	−400° to 1000° F.
Pressure	500 psi
R.P.M.	80,000 plus

These known operating ranges indicate the function of this seal. It is designed for applications where temperatures and mediums to be sealed forbid the use of any organic materials. Typically, these applications include fuel pumps, compressor power units and turbine starters characteristic in rockets and missiles. Other applications include mechanisms which are exposed to a high level of radioactivity.

Design Advantages

The C/R metal bellows seal consists of a metal bellows — a welded homogeneous unit which is secured at one end — and a carrier ring in which the sealing face is mounted. The seal does not contact the shaft. It is stationary, and the only rubbing surfaces are the sealing face and mating ring. These surfaces are precision lapped to provide a positive seal with minimum friction. At any given pressure, the seal can be designed to maintain proper and constantly effective face loads. It orients immediately to run-out and will resist any torques it is subjected to in operation. The design has high end-play tolerance: Chicago Rawhide engineers have deflected a bellows .100 in. for three million cycles at 1750 cpm and at a temperature of 500° F. with no adverse effects.

A further advantage is relatively light weight and compactness. The C/R metal bellows seal can be designed for minimum axial and radial space. Axially, complete seals can be produced within a ¼ in. cross-section. Radially, dimensions are comparable with conventional end face seals.

The C/R metal bellows seal can also be designed with an extremely low coefficient of expansion. The importance of this factor becomes apparent with the fact that in many applications the operating temperature may change hundreds of degrees in a very few seconds.

Mediums To Be Sealed

Virtually any known liquid or gas may be positively sealed with this design, depending upon duration or service life. From a practical viewpoint, the C/R metal bellows seal is the best design for the sealing of cryogenic and high-energy fuels such as LOX, hydrogen peroxide, fluorine and other missile and rocket propellants.

Where possible, lubrication of the two sealing faces is desirable to prolong service life. However, the medium being sealed commonly acts as the lubricant and may be merely hot gas.

Materials

Sealing faces and mating rings for the C/R metal bellows seal are available in a variety of materials including carbons, carbides, ceramics and various alloyed metals for both high temperature and corrosion resistance. The bellows can be furnished in any of several metals and alloys such as stainless steel, Monel, Inconel X, Ni-Span C and other special alloy steels.

Consult C/R Engineers

Each application for the C/R metal bellows seal is essentially a custom-design and an intimate knowledge of all conditions to be encountered must be known by Chicago Rawhide engineers to produce the correct combination of properties in the seal. Then, whether you require five, fifty or five thousand seals, Chicago Rawhide will design and produce the correct seal to solve your problem.

Helpful Design Data:

We will gladly furnish you with a design guide and space envelope data concerning the C/R Metal Bellows Seal. Just write for Bulletin MBS-1 on your company letterhead.

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